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# URBAN WOOD WASTE IN MICHIGAN: SUPPLY AND POLICY ISSUES

## FINAL REPORT
## SEPTEMBER 1994

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J.D. Snyder, Senior Consultant
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# Introduction

We commenced our project with a review of current literature about wood waste generation, disposal, and end markets which provided an overview of wood waste issues and helped frame the content and our analysis of urban wood waste. This overview includes characterizations by state agencies of wood waste residue generated by primary manufacturing (mills and forest harvesting), secondary wood manufacturing, and urban tree trimming and landscape operations. An earlier report (1991) by the Illinois Department of Energy and Natural Resources, which examined the entire range of operations generating wood waste, provided a helpful basis for this phase of the project.

This review provides an understanding of waste generation research methodologies and the corresponding quality of data. It also includes a brief overview of wood waste regulatory issues and the dynamic character of secondary wood waste markets. Based on the insight gained from the literature review, we moved on to the central phase of the project, which was the execution of original research.

Three survey instruments were designed to elicit data about the types and quantities of urban wood waste (UWW) generated in the Detroit, Lansing, and Grand Rapids markets. The three survey groups included solid waste and recycling coordinators, wood waste brokers and processors, and urban forestry and landscaping operators. Copies of the survey instruments are included as Appendix A.

The first survey instrument consisted of 12 questions and was used as a guide for the discussions with coordinators for the counties of Ingham, Eaton, Clinton, Kent, Macomb, Oakland, and Wayne and the City of Lansing. In all cases, recycling and solid waste coordinators emphasized that they lacked even basic knowledge of urban wood waste types and their generation. They consistently pointed out that the estimates of wood waste in their county solid waste management plans, which are required under the Michigan Solid Waste Management Act (PA 641 of 1978), were arbitrary and unreliable.

The second survey instrument was designed for interviews with UWW processors and haulers. Fifty firms of the 86 listed in the *Michigan Recycled Materials Market Directory: Pallets and Wood Processors/Brokers,* published by the Michigan Office of Waste Reduction Services, were contacted for telephone interviews between June 20 and July 29. Thirty-six firms were excluded because they were outside the study area, not processing or hauling wood waste, or out of business. Of the 50 firms within the scope of the study, 44 agreed to be interviewed and to provide information, for a total response rate of 88%.

The survey instrument used for these interviews consisted of 14 questions designed to elicit data about current and past UWW generation, future trends, processing capacity, and end markets for UWW. This instrument served to guide a structured interview comprised of both open- and closed-ended questions, a format which assured that all key topics of the study were covered while allowing respondents to introduce a broad range of issues. Consequently, a robust picture of the UWW market place and its dynamics was elicited.

Project staff interviewed 19 UWW haulers and processors located in Detroit, four in Lansing, and 11 in Grand Rapids. In addition, 10 firms responded to the survey from other areas, including Flint, Port Huron, Jackson, Battle Creek, Muskegon, and Kalamazoo. Although there was an inclination to aggregate these "other" markets with the targeted study markets, we did not do so. We believe this approach enhances the accuracy of the UWW generation estimates for each market area.

The third survey instrument was designed for interviews with urban forestry departments and landscaping operators. It consisted of five questions and was used in 19 interviews with city and county parks and forestry departments, university grounds departments, and utility tree trimming operations. This survey enabled us to augment our data about the generation and disposition of urban tree trimming residue, which was underreported in our survey of haulers and processors.

Data from the three surveys were tabulated to provide frequency distributions and descriptive statistics over all company sites and major customer locations. Statistics are provided on the quantity of each type or stream of wood waste currently processed or hauled, changes from

past quantities and volumes, estimated handling capacities, and current markets for selling processed UWW. Data regarding these factors were also used to calculate the total quantity of urban wood waste, total number of customers, and capacity utilization rates. In addition, open-ended responses were extremely useful in our effort to understand and describe the trajectory of the UWW market.

Our surveys elicited data reported in both weight and volume measurements. However, in the interest of enhancing the comparability of our data, we utilized conversion factors to obtain a common unit of measurement.

In our reliance on processors and haulers for UWW data, we are restricted to measuring UWW that is hauled and processed by these firms. Our methodology did not allow for measuring the quantities of UWW generated by small quantity generators who landfill or incinerate their UWW as part of their municipal solid waste (MSW) stream or who otherwise dispose of their own UWW. Thus, that quantity of UWW commingled with the overall MSW stream is not assessed or characterized in this study. The magnitude of this UWW generation may be significant, but it is beyond the scope of this study to measure or quantify the extent of the commingled stream.

In addition, interviews were conducted with waste management experts in the automotive and railroad industries; pallet producers; Michigan Department of Natural Resources forest management, air quality, and solid waste management staff; US Environmental Protection Agency (EPA) staff; Michigan legislative staff; major wood-burning cogeneration and electric-generating facility managers and developers; other consultants; and Public Service Commission staff. In all, nearly 120 interviews were conducted.

The strength of this methodology is that data generated from several sources can be compared and refined, thereby increasing the accuracy of our conclusions. It must be emphasized that the quantities of UWW estimated by respondents are self-reported. Nevertheless, we are confident that these reported quantities of processed UWW provide reasonably accurate approximations of recoverable, "clean" UWW in the market study areas. "Clean" in this context refers to uncontaminated and untreated natural wood products and

residue that are generated by a broad range of industrial, commercial, municipal, agricultural, construction, and demolition activities.

The widespread understanding of the value of clean UWW in various secondary end markets creates a relatively strong market for UWW processors and haulers. This also creates a reasonably effective mechanism by which UWW generation can be measured.

On the other hand, underreporting of "treated" UWW generation is certain. "Treated" refers to chemical alteration of the natural wood by binders, adhesives, preservatives, glues, resins, paints, stains, or coatings. It needs to be emphasized that these definitions are evolving terms and not fixed by any regulatory framework. As such, these terms are not as rigorously and exactly defined as other waste stream constituent terms like high-density polyethylene, corrugated cardboard, or even yard waste.

There currently is no reliable way to accurately quantify the generation of those treated UWW streams without extensive and costly empirical field study and measurements. Most treated wood does not currently have secondary end-market potential. It must be landfilled, stockpiled, or otherwise disposed. Most of the treated UWW, then, gets commingled with the other materials disposed as part of the overall MSW stream.

In the following pages, the results of our research are presented. To provide a background and context, this report begins with our literature review. This is followed by the results of the survey research, which encompasses the bulk of the report. Finally, we present a discussion of regulatory issues and policy issues likely to affect UWW markets.

# Literature Review

Our purpose here is to examine the existing literature about the types and quantities of urban wood waste generation, associated disposal practices, and end markets for fuel and non-fuel uses.

**Urban Wood Waste Generation Estimates and Landfill Tip Fees**

The two most recent reports by the United States Environmental Protection Agency (EPA) on the characterization of municipal solid waste were published in 1990 and 1992 and assess data for 1988 and 1990. Estimates of the urban wood waste (UWW) stream changed substantially in these reports. The 1994 report will be published this fall and will contain comparative and more detailed data for 1991-93, particularly about UWW.

*Municipal solid waste (MSW),* according to the EPA definition, includes durable and non-durable goods, containers and packaging, food wastes, yard wastes, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Specific examples include appliances, wood pallets, office and classroom paper, newspapers, and disposable tableware.

*Generation* refers to the amount of materials and products as they enter the waste stream and before materials recovery, composting, or combustion (incineration) takes place.

*Recovery* is specifically defined as removal from the waste stream for the purpose of recycling and/or composting. Materials that were separated from the waste stream for recycling may simply be stored or, in some cases, sent to a landfill or incinerator. Thus, EPA does not treat wood combustion in cogeneration facilities as recovery of wood materials.

According to the 1990 MSW characterization report, 6.5 million tons of wood waste were generated in 1988, and none of it was recovered. Both figures indicate significant

underreporting. Wood waste was estimated to be 4.2% of MSW weight or 4.1% of MSW volume. Overall, MSW generation was estimated to be 180 million tons per year.

The 1992 MSW characterization report substantially increased the estimate of the wood waste stream, from 6.5 million tons to 12.3 million tons, or 7% of MSW in 1990. According to EPA staff, this estimate was based primarily on National Wooden Pallet and Container Association data that indicates 536 million pallets were produced in 1990. Wood pallet production has steadily increased since 1990.

For the first time, EPA reported a positive value for the recovery of wood waste. That figure is estimated to be 0.4 million tons, or a recovery rate of 3.3%. Recovery estimates, then, are limited to recovery for use by secondary markets for composting and mulch.

The 1992 report represents a substantial improvement in EPA's estimates of the UWW stream. However, this data base remains limited by its virtually exclusive reliance on pallet generation data to characterize the generation of the UWW stream.

Landfill fees continue to increase. According to the National Solid Wastes Management Association, the national average tipping fee for 1992 was $30.21 per ton, up 14% from their 1990 survey. Midwestern tipping fees are below the national average at $27.10, up from $23.15 in 1990. Tipping fees are expected to continue to rise as a result of the implementation of RCRA Subtitle D landfill requirements.

Alternate uses for wood residue include boiler fuel, particleboard, molded products, landscaping, mulch, and animal bedding. Information about the specifics of these markets is detailed below.

**State Characterizations of Wood Waste in the Great Lakes Region**

Four state reports published since 1991 provide data about wood waste and utilize methodologies relevant to the Michigan urban wood waste study. Each of these reports assesses some aspect of UWW generation, disposal, and markets; none, however, provides an overall characterization or assessment of urban wood waste.

The reports reviewed include studies by the Illinois Department of Energy and Natural Resources on the state's entire wood waste stream (1991), an assessment of wood waste generated by the secondary wood products manufacturing industry in Wisconsin (1993), an assessment of wood and paper residue generated by the Michigan secondary wood products industry (1994), and an assessment of urban tree residue in the Minneapolis/St. Paul area of Minnesota (1992).

Wood Waste Disposal in Illinois. The 1991 Illinois Department of Energy and Natural Resources (IENR) study of wood waste disposal was designed to investigate the feasibility of a ban on landfilling wood waste (including construction and demolition material). This study estimated that 1,425,478 tons of wood waste were generated annually in Illinois. Of this total, 463,319 tons per year were landfilled. The wood waste stream was characterized by five generating sectors and the quantities generated by each are displayed in Table 1.

Table 1. Illinois Wood Waste Generation Estimates

| Generating Sector | Annual Generation (in Tons) | % of Wood Waste |
|---|---|---|
| Primary wood producers | 190,800 | 13.4% |
| Secondary wood manufacturing | 443,053 | 31.1% |
| Construction/demolition debris | 507,000 | 35.6% |
| Commercial | 250,000 | 17.5% |
| Residential | 34,625 | 2.4% |

Primary wood producers, secondary wood manufacturers, and construction/demolition waste sectors were surveyed for waste stream estimates, and the residential and commercial sector estimates were derived from computer modeling.

Only a small fraction of wood waste generated by primary wood producers was landfilled. The major secondary uses for wood waste by this sector included heating fuel, mulch, livestock bedding, and other wood products. Secondary manufacturers reported that 77% of their wood waste was reused as fuel, compost, or other wood product manufacture. An

estimated 23%, or 102,908 tons, was landfilled. It was reported that these manufacturers were trying to find alternatives to landfilling wood wastes because of rising tipping fees.

IENR staff struggled to derive a reliable estimate of the construction/demolition (C/D) stream. Since C/D waste is commonly commingled with other waste streams, it is very difficult to estimate the amount of C/D disposal in sanitary landfills. Estimates of quantities landfilled in dedicated C/D landfills underreport C/D landfilling, since C/D waste is disposed of in sanitary landfills as well as C/D landfills. Consequently, IENR staff used a C/D waste generation formula of 0.72 lbs/capita/day consisting of 30% wood waste. It is not stated in the report how this formula was derived. The statewide estimate of C/D wood waste was calculated to be 507,335 tons per year. IENR found, then, that C/D wood waste accounts for 40% of the total wood waste disposed of in landfills.

Using the WastePlan model,[1] IENR derived wood waste estimates of 250,000 and 34,625 tons for the commercial and residential sectors, respectively. The data set provided by the model estimated a proportion of total waste that is wood for several commercial sectors and used the number of employees and retail revenue estimates to derive wood waste estimates. Significantly, IENR was unable to quantify the amount of waste that was reused or recycled. According to the report, "pallet recycling...could account for a significant reduction in the amount of commercial wood waste that is actually disposed of by landfilling."

IENR urged the Illinois legislature to take no action on the wood waste ban, stating that pressures from rising landfill fees were acting as an incentive for generators to find alternative uses for wood residue. Since Illinois requires that yard waste be segregated from other MSW for composting, IENR recommended that wood residue be designated for composting as well. Finally, the study recommended that the State Pollution Control Board reconsider its permit procedure in order to encourage coal-fired generating plants to burn wood as well.

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[1]WastePlan is a software program designed for integrated solid waste planning. It analyzes and compares different scenarios for waste generation, collection, composting, recycling, reduction, landfills, and waste-to-energy facilities.

Wisconsin Wood Residue Study: Wood Residue from Manufacturing Excluding Sawmills. The 1993 *Wisconsin Wood Residue Study* was designed to identify the quantity, type, location, and disposal methods of the industrial wood residue stream. This study also considered the potential for industrial development using wood residue through a feasibility analysis of a hypothetical wood residue-fired electrical generation plant. A directory of residue-producing firms was also published in conjunction with the study.

Survey mailings, including two follow-ups, were used to collect data from 5,837 wood-using and non wood-using Wisconsin businesses in 1992. Fifty-six percent (3,251) of the businesses surveyed responded, and 47% of those stated that they generated wood residue. Survey numbers were not adjusted to a green or dry basis but were weighted using a disproportionate stratified sample to provide an aggregate for each industry sampled.

The results of the survey were compiled and analyzed by SIC group, forest survey unit (five geographic regions), number of employees per firm, disposal method, and disposal cost. SIC codes 24 (Lumber and Wood Products) and 26 (Paper and Allied Products) were analyzed separately, since the amount of wood residue each produces would have skewed the results. The objective of the survey was to sample manufacturing and service firms most likely to generate high volumes of wood residue not currently being utilized.

Wisconsin firms produced an estimated 2,152,046 tons of wood residue annually. Wood residue consists of pallets, dunnage (wood packing material), sawdust and sanderdust, chips and shavings, edging and cut-off, and bark. Pallet residue accounted for 133,000 tons annually, and nonpallet residue accounted for 2,019,000 tons. SIC code group 24 (Lumber and Wood Products, excluding sawmills) generated 1,432,000 tons of nonpallet residue and 22,000 tons of pallet residue. Possible uses for the wood waste stream included particle/inorganic bonded board, fireplace logs, molded products, fuel, pulp, animal bedding, and landscape mulch.

The Wisconsin survey showed that mid-size firms generated the most wood residue. Although the authors did not define mid-size firms, it appears that they included firms of 100-249 employees, 50-99 employees, and 20-49 employees. The authors believe there is a

correlation between the number of production employees and the amount of wood residue generated.

Table 2. Wisconsin Estimates of Wood Residue Generation By Number of Employees per Firm

| Number of employees | Number of firms | Pallet Generation | Nonpallet Gen. | Total |
|---|---|---|---|---|
| 5-19 | 14,402 | 6,894 | 364,339 | 371,233 |
| 20-49 | 4,050 | 10,929 | 475,397 | 486,326 |
| 50-99 | 1,643 | 54,473 | 218,854 | 273,327 |
| 100-249 | 1,188 | 31,800 | 568,809 | 600,609 |
| 250-499 | 347 | 9,029 | 184,837 | 193,866 |
| 500+ | 266 | 19,662 | 207,022 | 226,684 |
| TOTALS | 21,896 | 132,787 | 2,019,258 | 2,152,045 |

As shown in Table 2, Wisconsin firms generated nearly 133,000 tons of pallet residue. Firms with 50-99 employees accounted for 41% of its total production. For nonpallet residue, firms of 100-249 employees generated 28%; firms of 20-49 employees generated 24%; and firms with 5-19 employees generated 18%. The study methodology and data do not permit a determination of the amount of residue generated by each employee.

Nearly 500,000 tons of wood residue were disposed of through various methods. Residue generation was concentrated in the Southeast survey area (70%). This area also experienced the most acute disposal problems.

Disposal methods varied widely by wood waste type. Non-pallet residue (429,000 tons) was predominantly sold (39.8%) or given away (25.4%), while pallet residue (69,000 tons) was predominantly landfilled (28%) or given away (26%). Significantly, 25% of the disposed pallets in Wisconsin were classified as being disposed of by "unknown" means. This figure comes to 17,112 tons per year, or nearly 68.5 tons per day. These pallet residue disposal findings are surprising in light of the findings in our study.

Table 3. Wisconsin Estimates of Wood Residue Disposal by Disposal Method (tons/year)

| Disposal Method | Total Pallets | Dunnage | Saw/ Sander | Chips/ Shaving | Edging/ Cut-off | Bark | Other | Total Nonpallet | Comb. Total |
|---|---|---|---|---|---|---|---|---|---|
| Landfill | 19,095 | 10,134 | 3,001 | 5,122 | 13,016 | 780 | 8,779 | 40,832 | 59,927 |
| Stockpile | 594 | 104 | 7,287 | 6,836 | 456 | 31,595 | 64 | 46,342 | 46,936 |
| Sell | 6,822 | 1,784 | 72,898 | 88,711 | 3,753 | 2,762 | 1,992 | 178,722 | 178,722 |
| Giveaway | 17,654 | 3,056 | 5,178 | 6,887 | 10,077 | 1,096 | 83,098 | 127,392 | 127,046 |
| Pay to remove | 4,373 | 2,548 | 5,927 | 2,549 | 5,349 | 0 | 218 | 16,591 | 20,964 |
| Incinerate | 3,301 | 6,115 | 7,420 | 7,008 | 5,738 | 2,207 | 2 | 28,530 | 31,831 |
| Other | 344 | 113 | 46 | 16 | 45 | 0 | 0 | 220 | 564 |
| Unknown | 254 | 254 | 1,092 | 11,937 | 2,208 | 0 | 87 | 15,578 | 32,744 |
| TOTAL | 24,148 | 24,148 | 102,849 | 129,066 | 40,642 | 94,240 | 94,240 | 429,385 | 498,734 |

Landfilling was the most common disposal method for dunnage (42% of 24,000 tons). Sale was the most common disposal method for sawdust and sanderdust (71% of 129,000 tons) and for chips and shavings (69% of 129,000 tons). Edging and cut-off residue were predominantly disposed either by landfilling (32%) or giving away (25%). Bark was mainly stockpiled (82% of 38,000 tons). Residue classified as "other" was chiefly given away (88% of 94,240 tons). See Table 3 for more detailed information.

The study concludes with a discussion of the feasibility of building a 25 MW wood-fired electrical generation facility. It was found to be a profitable investment. However, the authors assumed a wood cost of $8 per delivered ton. Our research indicated that wood prices in Michigan are at least twice that amount. Further, transportation costs, which are a major factor in determining fuel prices and the profitability of wood-fired generators, were not included in the Wisconsin assessment.

Michigan Wood and Paper Residue Study: Secondary Wood Products Manufacturers. A survey of secondary wood manufacturing residue generation was published by the Forest Management Division of the Michigan Department of Natural Resources in March, 1994. The survey was conducted in late 1993. Secondary wood manufacturing consists of cabinet

manufacture, furniture manufacture, pallet manufacture, wood boxes, wood products, hardwood dimension or furniture parts, millwork, corrugated sheet pit, paper converter, and other. Secondary wood products manufacturing is distinguished from primary wood products manufacturing in that it does not involve the harvesting of trees or using roundwood in their manufacturing processes.

The survey methodology was based on the 1993 report published by the Wisconsin Department of Natural Resources (Everson and Hubing 1993). The goal of the Michigan study was to facilitate the use of wood and paper residues as raw materials or energy sources.

The report identified location, volumes, and types of wood and paper residues produced by secondary wood products manufacturers in Michigan. The report also compared the amount of each type of residue being landfilled to its potential as an energy source. Finally, the report provided information on the willingness of waste generators to pay or charge for having wastes made available to a power plant or broker.

Results showed that 868,478 tons of wood and pallet wastes are produced annually by the 477 respondents (out of 1,687 surveyed) and 63,623 tons of paper residues. This suggests, according to the report, that the secondary manufacturing industry produces over 3.3 million tons of residue annually. This includes pallets and all other wood residue as well as paper residues from secondary wood product manufacturers. Wood chips comprised the largest amounts of residue at 51.5%. Sawdust was the second largest waste product (22.7%), followed by bark (16.5%). This total can also be divided into "clean" (855,846 tons) and "composite" (21,468 tons) wastes.

The primary means of disposal is use as a fuel: 596,748 tons of wood, or 68.3%, is used annually as an energy source while recycling makes up 24.2% (213,187 tons) of the total. Other unidentified uses accounted for 6.8%, or 58,894 tons. Only a small percentage (.09%), or 6,609 tons, of the total annual wood waste produced by secondary manufacturing was landfilled. Still, the estimated potential represented by the amount of wood landfilled is over 360,000 MMBtu (million British Thermal Units) for survey respondents and 602,000

MMBtus for all secondary manufacturing. Landscaping was a common use for wood residue, especially bark and chips and shavings. Chips and shavings were also commonly recycled as animal bedding.

This study did not provide a geographic analysis by county, SMSA (Standard Metropolitan Statistical Area), or DNR Region. Instead, it reported waste generation by utility company service territory. In contrast, the *Michigan Wood Products Industry Residue Directory,* which uses the same database, is divided by county (MDNR 1994). As a result, it is not feasible to compare or aggregate the secondary manufacturing data with our urban wood waste data to achieve a more comprehensive and precise characterization of UWW.

Urban Tree Residue: An Assessment of Wood Residue from the Seven-County Metro Area of Minnesota. The 1992 *Urban Tree Residue* study by the Minnesota Department of Natural Resources estimated the generation of urban tree residue in the Twin Cities area. As such, this report assessed only one component of the urban wood waste stream. End-use of this stream is important in light of a 1992 Minnesota ban on landfilling tree and shrub waste. The findings of this report may suggest some ramifications of Michigan's yard waste ban, slated to go into effect in March of 1995.

The Minnesota study found that approximately half of the 325,000 tons of urban tree residue produced per year was used. The other half was considered a waste disposal problem. Only 14% of the residue produced any revenue. Of the 86% that did not produce revenue, 41% cost money for disposal. Six basic factors prevented marketing the residue successfully:

1) Excess supply vs. weak demand
2) Too few existing recycling sites and location problems with proposed expansions
3) Lack of public information on the subject
4) Low priority on wood residue recycling
5) Absence of comprehensive public policy
6) Lack of active industry organization

In order to overcome these difficulties, the Minnesota DNR recommended increased coordination between producers such as tree services, utilities, and land developers, and

consumers such as landscapers, firewood users, and homeowners in order to increase demand.

It was also concluded that more sites for recycling were needed, however, social constraints relating to siting make this difficult. Demand for waste wood is only one-tenth of the current available supply. Without market demand, there is no real monetary value to the wood. Since it is illegal to landfill urban tree residue in Minnesota, reuse is essential.

The Minnesota DNR suggested a series of both long- and short-term actions. Short-term actions included creating publicity for free chip mulch, opening at least two new recycling sites, encouraging new chip fuel users, exploring firewood "exchange yards," and increasing the demand wherever feasible. Over the long-term, finding manufacturers who might use the residue as raw material was imperative. Another option was to test the feasibility of stump incineration. In order to implement these provisions, it would be essential to establish control of the material stream and seek legislation providing financial incentives to new users of chip fuel for boilers and cogeneration.

**Other Studies**

*Michigan Timber Industry: An Assessment of Timber Product Output and Use, 1990* (Hackett and Pilon 1993) provides data from a survey of all primary mills in Michigan that use logs and bolts, as well as major consumers of industrial fuelwood. This report includes information on wood residue generation by Michigan primary manufacturing and thus complements the *Michigan Wood and Paper Residue* assessment of secondary wood manufacturing. These two reports set the stage for our study of UWW.

Information is provided for the volumes of the types of wood (hardwood and softwood species) harvested and used for saw and veneer logs, pulpwood, industrial fuelwood, poles, posts, and other products. The data is presented for Michigan's 83 counties and by Forest Survey Unit (Eastern Upper Peninsula, Western Upper Peninsula, Northern Lower, and Southern Lower Peninsula).

Industrial roundwood production in 1990 was 347.3 million cubic feet, down from 355.2 million cubic feet in 1988. Industrial fuelwood production declined from 21.9 million cubic feet to 14.8 million cubic feet, a drop of 32%. Primary mill wood residue used for industrial fuel was 385,130 tons, according to the report. Industrial fuelwood represents approximately 4.3% of industrial roundwood production. There were 355 active mills operating in 1990, an increase of 62 from the industry's low point of 293 in 1975.

The total amount of material harvested from timberland for industrial roundwood was 428 million cubic feet. Of that total, 81.3 million cubic feet, or 19%, was left on the forest floor as logging residue. Residue material includes tops, limbs, cull material, and growing-stock material not used for product. Over 30% of this harvest residue was in the Upper Peninsula.

Ninety-six percent or more of each mill residue class (coarse, fine, and bark) generated in Michigan primary mills was used. Primary wood-using mills, except pulp, particleboard, and waferboard mills, generated 807,000 green tons of coarse residue, 503,000 green tons of fine residue, and 359,000 green tons of bark. Pulpwood mills consumed 59 percent of the coarse mill residue for fiber products. Other industry and households consumed 33 percent of the coarse mill residue for fuel. Fine mill residue and bark were used for industrial fuel, soil conditioner, mulch, livestock bedding, and poultry litter.

Beyond these five studies, little non-proprietary work has been done to analyze the disposal of urban wood residues. The authors of this report are aware of at least two proprietary market studies of urban wood waste. They have been conducted by Resource Recycling Systems, Inc. for the CMS facility under construction in Genesee County and by a California-based firm for the proposed Decker Energy and Wheelabrator facility in Albion.

It should be noted that the problem of utilizing and disposing wood waste is not restricted to the past decade. In the mid-seventies, Woodwastes Utilization and Disposal (Cheremisinoff, et. al., 1976) was published, which related case histories of disposal problems and solutions for areas such as Detroit, Flint, Pontiac, and Lansing. The end-use options identified in this study were similar to those currently utilized or being investigated, including animal bedding, mulch, particleboard, and fuel.

**Regulation of Urban Wood Waste as Fuel**

As landfill costs increase, waste generators seek more cost effective management of their waste stream. Although the use of wood waste as an energy source is clearly feasible technologically, public acceptance of wood-fueled energy facilities has been limited in many regions of the country. Regulatory confusion and decreasing incentives deter further development of the biomass energy market. These barriers assume several forms.

First, uncertainty over defining wood combustion leads to excessive regulation. The most comprehensive study of the issue, *Wood Products in the Waste Stream: Characterization and Combustion Emissions*, reviews state regulations in California, Connecticut, Vermont, New York, North Carolina, Wisconsin, Washington, Virginia, and New Brunswick (NYSERDA 1993). All of these states consider the use of wood waste for combustion as reuse rather than recycling. In the waste management hierarchy, the best possible use for wood residue would be as a feedstock in another product rather than as a fuel with no opportunity for another cycle of recycling or reuse. Combustion creates ash and air emissions that would be avoided if the wood was transformed into a product with additional uses, such as fiberboard. As a result, use of wood waste for combustion does not contribute to state recycling goals. Several of the states within the study area have adopted recycling goals of 25 to 50 percent. Because the use of wood waste as a fuel does not contribute to this goal, there may be "less incentive for solid waste managers and regulatory staff to review and permit waste wood facilities" (NYSERDA 1993:2-37).

Another set of problems results from a gap between regulatory terminology and technical capacity. Definitions for "clean" and "treated" wood either do not exist or vary from state to state. Of the eight states studied in *Wood Products in the Waste Stream*, seven have specific definitions for clean waste and only four have definitions for treated wood (NYSERDA 1992:2-38). In most states, the combustion of clean wood waste is considered energy recovery, while the combustion of "treated" wood waste is considered incineration. This means that facilities that burn "treated" wood are legally the same as municipal solid waste incinerators.

The NYSERDA report defines three categories of waste wood: urban wood waste, mill residue, and harvested wood. UWW consists of pallet waste, construction and demolition wood waste, and municipal solid waste wood. Mill residue is generated by primary and secondary wood manufacturing. Harvested wood includes site conversion waste wood, silvicultural waste wood, and agricultural residue.

Confusion over the regulatory definition of waste wood is partly derived from having so many regulatory entities involved in the creation of regulatory schemes. Wood waste combustion is, both at different times and at the same time, treated by air quality officials the same as incineration, by utility regulators as energy production, by solid waste officials as municipal waste, and by forest management officials as harvesting residue.

One of the unintended consequences of this regulatory confusion is the risk of creating and supporting public misperception and misunderstanding. The EPA Environmental Appeals Board recently heard a permit appeal raised by several groups in Flint regarding a proposed 35MW cogenerating facility in Genesee County. Criticism focused on toxic emissions that might result from inadequate fuel handling procedures. The permit application included C/D demolition as part of the proposed facility's fuel supply so, concerns were raised over lead and other toxic emissions. The EPA ruled that a comprehensive fuel handling and management protocol would be sufficient to assure that the fuel would not produce toxic emissions (US EPA 1993). It is questionable whether public opposition would have been as great had public discussions centered on the development of a "power plant" rather than an "incinerator," especially when wood combustion emissions are compared with coal-fired plant emissions. The latter, of course, are a major contributor to acid rain and global warming from atmospheric $CO_2$.

The uncertainty created by the lack of a clear regulatory definition of "treated" wood makes permitting procedures difficult. In Michigan, a test burn of six types of chemically-treated wood at the Viking Energy facility in McBain is scheduled for September 1994 and should provide specific regulatory clarification. Combustion of railroad ties, telephone poles, construction and demolition debris, plywood and particleboard, and TDF (tire-derived fuel) will be analyzed for the impact of their emissions. If the results of air emissions tests for

these materials meet regulatory standards, the wood fuel supply available to power producers will increase substantially.

In addition to regulatory confusion, the use of wood fuel for energy production is hampered by the weakening of incentives. The enactment of the Public Utility Regulatory Policies Act (PURPA) in 1978 worked to encourage entry in the energy market by requiring utilities to purchase power from independent producers (IPPs) at "avoided cost rates." Renewable energy tax credits made investment in independent power projects more feasible. These tax credits were phased out in the 1980's and avoided cost rates have been plummeting.

As a result, independent power producers have been caught in a "scissors crisis:" not only are the incentives to help achieve profitability nonexistent, but the rates that independent producers receive for the energy that they sell to utilities have been plummeting. Swezey, et.al., (1994) advocates broader incentives to encourage entry into the biomass energy market. These include the use of "set-asides" to require that a certain percentage of a state's total power production must come from biomass and "green RFPs" designed only for renewable energy production.

Finally, externalities need to be considered in a broader sense so as to emphasize the economic development potential of biomass energy. Solving these problems are essential to the long-term viability of the wood fuel market. Though an abundant supply of raw materials exists (NYSERDA 1992), it is clear that there remains little interest by investor-owned utilities in the use of wood residue. Refining regulatory policy along the lines suggested in the Swezey study would be a good first step.

**Competing End Markets: Higher Value-Added Uses for Wood Waste**

Fiberboard, wood/plastic composites, composting agents, and mulch markets compete with wood-fired power plants for urban wood waste. These end markets compete more aggressively with the fuel market as virgin timber prices rise, consumer demand for recycled wood products increases, and technological improvements in recycled wood production reduce costs.

It is clear that a substitution effect exists in the wood waste market: as the price of virgin timber increases, innovations come to the fore. Competitive pressures are more severe in the fiberboard industry, which must often compete with paper mills for raw materials (Blackman 1991:19; Plantz 1994:115). This supply uncertainty has fueled new attempts to secure reliable sources of materials, and urban wood waste is foremost among them. Use of this stream has several advantages.

First, urban wood waste contains many elements already used by fiberboard manufacturers, such as chips and sawdust. Second, technical problems associated with using urban wood are easily surmountable (Suchsland and Woodson 1986:35). Adequate precautions must be taken to remove metals produced in chipping. One processor uses hogged pallets to supply one-third of the yearly production of a hardboard manufacturer in Oregon (Blackman 1991:19). Another Northwest US particleboard mill uses 6,000 tons of recycled wood each month, including construction and demolition debris, in its production. The recycled wood stream represents 15% of its total raw materials supply (Plantz 1994:115).

Most important, new technologies hold the promise of creating fiberboard exclusively from waste wood and other MSW. Two plants are under construction in San Diego and Toronto that will each use 100,000 tons of waste per year to create a completely recycled commodity. Siting such a facility in an urban area close to the fuel supply has another advantage — lower costs. The company, CanFibre, estimates that it can "deliver high quality MDF to the market at a cost up to 45% less than current manufacturers" (Wood Technologies 1994:7).

Another use for waste wood lies in the creation of new wood/plastic composites. Separated wood can be processed into fiber that can be mixed with plastic. Wood flour is mixed with polypropylene to make interior panels for the auto industry. For example, Ford currently uses material that contains 77% wood fiber in the Aerostar minivan. This new material is "useful in a wide variety of commercial applications and value-added products" (Youngquist, et.al. 1993:3). Any type of wood waste can used in this procedure. One Massachusetts firm processes 150 tons per day of construction and demolition debris into wood fiber, which can be made into doors and ceiling tiles (Steuteville 1992 :39).

Wood waste can also be used as a composting agent. It can be added to grass clippings and tree limbs or can serve as a bulking agent for sludge composting. Shredded pallets are attractive because of their very low moisture content (Goldstein 1992:77). Their high carbon to nitrogen ratio also makes them ideal to mix with grass clippings (Logsdon 1992:39).

Finally, wood chips are used as a mulch for landscaping. Many park systems use their shredded tree residue as trail markers and around trees or give it away to the public. Other wood processors sell their waste to nurseries, who in turn dye it for use with their clients. The Forest Service is taking this idea a step further and developing a biodegradable mulch mat for use around tree seedlings (Pieper 1993:42).

# Urban Wood Waste Stream Components

This section analyzes and assesses the data for the nine components of the urban wood waste (UWW) stream based on our survey interviews with 44 UWW haulers and processors and 19 urban foresters. Survey data and information about the types and estimated quantities of urban wood waste were supplemented by information obtained in interviews with automotive environmental and materials handling staff, pallet manufacturers, National Wooden Pallet and Container Association (NWPCA) staff, and railroad environmental staff.

It should be kept in mind that written documentation and detailed reports to support these self-reported estimates were rare. However, by comparing generators' estimates of UWW quantities with processors/haulers' estimates of those quantities, a detailed and robust picture emerges. Thus, our study provides the most comprehensive and detailed non-proprietary assessment and characterization of UWW to date for Michigan or the U.S. We found no other study which disaggregated the UWW stream to the level of detail — nine components — employed in this study.

Even in the most definitive study of wood waste to date, conducted by Environmental Risk Ltd. and C.T. Donovan Associates in 1992 for the New York State Energy Research and Development Authority (NYSERDA), UWW was divided only into three components: pallets, construction/demolition, and MSW wood. That study also assessed generation and fuel use of wood waste in eight states, as well as one Canadian province, and included estimates of wood waste generated by harvesting (including site conversion, silviculture, and agriculture) and mill residue generated by primary, secondary, and plywood/veneer manufacturing. Thus, the NYSERDA study quantifies two components treated as UWW in this study — site conversion and plywood/veneer — in categories other than UWW.

Our characterization of UWW relies on data provided by wood waste haulers and processors. These self-reported estimates of the nine components found in the UWW stream establish a strong data base. As a first effort, it is not perfect, but subsequent research of this important

secondary material market will enhance precision. Moreover, by interviewing pallet manufacturers and pallet generators in the automotive industry as well as railroad company staff, we produced a robust and precise understanding of pallets and railroad ties as components of the UWW stream.

**Key Definitions**

Urban wood waste (UWW) is defined in this study as wood residue generated by municipal, industrial, commercial, construction, and demolition sources. "Urban" denotes the non-forestry origins of this waste stream; it does not literally mean the wood waste was generated only in urban areas. Nine components were identified in the UWW stream: pallets/dunnage, wood scraps, construction debris, demolition debris, railroad ties, tree trimmings, land clearing, plywood/particleboard, and other.

Market areas and the frame of analysis are defined here for the purposes of this study. We focused on the three major urban areas of Detroit, Lansing, and Grand Rapids in southern Michigan. Survey interviews were conducted with 44 UWW processors and haulers in these principal market areas as well as other urban areas in southern Michigan, including Muskegon, Jackson, Battle Creek, Kalamazoo, Port Huron, and Flint. The geographic distribution of these firms is 19 in the Detroit area, four in Lansing, 11 in Grand Rapids, and 10 in "other" urban areas.

Of the 44 respondents, 21 respondents indicated that they have Detroit area customers, seven indicated Lansing area customers, 12 indicated Grand Rapids area customers, and 12 indicated they have customers outside of those market areas.

Some haulers and processors indicated having customers in market areas outside of their facilities' market locations. The geographic distribution of UWW customers included: 37 processors who have customers in one market area, six processors who have customers in two market areas, and one processor who has customers in all three market areas.

For quantity reporting purposes in this report, we use the location of processors' facilities rather than the location of the customers for our frame of analysis. The structure of our

survey questionnaire did not permit precise tracking of UWW generation by customers where respondents indicated customers in more than one market area. Thus, generation estimates correspond to the location of the processing facility rather than the location of the UWW generator. Based on our analysis of the customer location data that we were able to obtain, we believe that this introduces only a slight variation in what the quantities would have otherwise been. Moreover, the location of the processor is more relevant to secondary market considerations than the original location of the generated UWW.

**Developing Used Pallet Generation Estimates**

The vast majority of the UWW hauling and processing market is in pallets: 93% of the respondents in the processors survey process or haul pallets. Used pallets dominate the UWW market because they are relatively clean, dry, and in abundant supply. They make good fuel and feedstock for secondary products.

Pallet Manufacturing and Characteristics. Pallets are relatively free of contaminants, although steel bands, shrink wrap, and corrugated cardboard are frequently attached to used pallets. Virtually all pallets have steel fasteners. Some pallets are chemically-treated or contaminated by chemical products during on or off-loading. In Michigan, pallet supply comes largely from the automotive industry, particularly in the Detroit area market.

Commonly used pallet sizes include 40"x48", 48"x48", 48"x45", 48"x40", and 42"x42". The flush stringer, double-faced, non-reversible pallet is the most widely used pallet. The 48"x40" pallet, used by the grocery industry, is the most common size.[2]

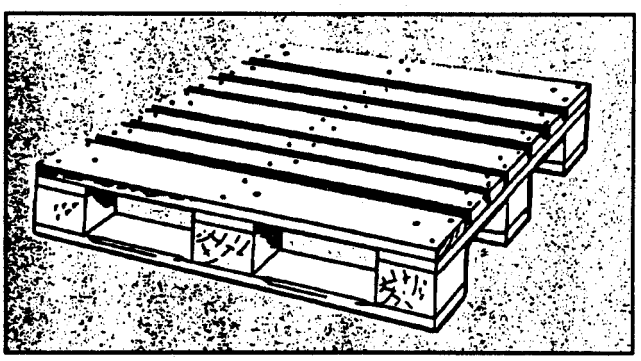

**Figure 1: 4-Way Block Design**

According to a 1991 study of the national pallet manufacturing industry by Southern Illinois University, Michigan had the largest number of pallet manufacturers in the U.S. with 298

[2]McCurdy, D.R. and J.E. Phelps, "Trends in the U.S. Pallet Industry: 1980, 1985, and 1990," Forest Products Journal, 42(1):28, 1992

firms. The same study estimated that 460 million pallets were produced in the U.S. in 1990. However, a national consultant with extensive experience in municipal solid waste assessment estimated pallet production of 536 million for the same year. Pallet production estimates for Michigan and the U.S. for the last six years are listed in Table 4. It is estimated that Michigan accounts for 5 to 8% of national pallet production, thus Michigan pallet production was between 30 to 47.9 million pallets in 1993.[3] We must rely on this estimate because a survey of Michigan pallet manufacturers was beyond the scope of this study.

Table 4. US & Michigan Pallet Production Estimates (in millions of pallets)

| | *U.S.* | *Michigan(a)* | *Michigan(b)* |
|---|---|---|---|
| 1988 | 465.8 | 25.3 | 37.3 |
| 1989 | 505.0 | 25.2 | 40.4 |
| 1990 | 536.0 | 26.8 | 42.9 |
| 1991 | 540.7 | 27.0 | 43.3 |
| 1992 | 565.0 | 28.3 | 25.2 |
| 1993 | 599.0 | 30.0 | 47.9 |

(a) Based on 5% of US pallet production
(b) Based on 8% of US pallet production

*Sources: Franklin Associates and Public Policy Associates, 1994*

The same study found that pallet firms sold 85% of their pallets an average distance of 92 miles from the plant. This average was skewed by a few firms selling nationally, however, the median distance firms sold pallets was only 50 miles from the point of manufacture, suggesting that state pallet production is a reasonably good indicator for state used pallet generation. Furthermore, the use of pallets by the automotive industry is characterized by suppliers delivering their palletized products to automotive manufacturers, resulting in the concentration of used pallet generation at automotive facility locations.

[3]Personal Communication with Bob Moore of Pallox, Inc., a major Michigan pallet producer and member of the National Wooden Pallet and Container Association (NWPCA), who estimated that Michigan production is close to 8% of national pallet production, August 2 and 10, 1994.

Automotive Industry Pallet Use and Waste Reduction. The Michigan-based automotive industry and its suppliers are major pallet generators. We sought to establish how many pallets are used annually by each of the Big Three (GM, Ford, and Chrysler). Estimates of used pallet generation varied substantially.

GM staff estimated that one pallet is used for each car produced and that 15,000 to 20,000 pallets are used per day in GM's North American operations. An approximate estimate of Michigan-based GM pallet use would be in the range of 10,000 pallets per day. GM staff further estimated that 25 to 33% of GM's pallets are reconditioned and reused. GM plants are using both wood and corrugated cardboard pallets, and GM has established a goal of zero waste disposed in landfills by the year 2000.[4]

Chrysler Corporation staff estimated that 20,000 pallets are used per day by Chrysler plants for 250 days per year. The fact that Chrysler reported generating the same level of used pallets as GM illustrates the character of these estimates as broad approximations. Chrysler staff, too, emphasized the zero discharge goal by 2000. It was also pointed out that the automotive industry, through the Automotive Industry Action Group (AIAG), is working with the NWPCA to establish standards for reusable wood containers. As reliance on reusable wood containers and pallets increases, the generation of used pallets by the automotive industry will decrease.[5]

Ford Motor staff stated that they did not know how many pallets are used in their automotive manufacturing operations.[6]

NWPCA staff estimated that five to 10 pallets are used in the production of each car. Interestingly, at least two sources cited a figure of 25 pallets used in the production of each car produced before waste reduction management was instituted over the past six or seven

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[4]Personal Communication with Ken Horvath, General Motors, July 21, 1994.

[5]Personal Communication with Karl Roberts of Chrysler Corp. Materials Handling, June 28, 1994.

[6]Personal Communication with Marshall Guerin, Ford Motor Company, June 27, 1994.

years.[7] We obtained Michigan automotive production data from the Ward's Automotive Yearbook for the past three years and have displayed it in Figure 2. Based on these figures, automotive pallet use for 1993 ranged from a minimum of 2.9 million to a median of 14.6 million up to a maximum estimate of 29.3 million based on one, five, or 10 pallets used per manufactured vehicle for 1993.

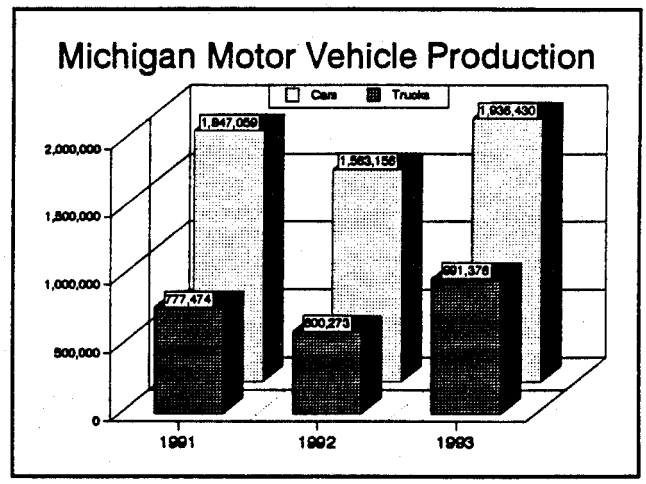

**Figure 2**

Automotive industry pallet use is probably at the upper end of this range. Until the industry-wide emphasis on waste reduction which began roughly six years ago, the rule-of-thumb estimate of 25 pallets per manufactured car was fairly consistent. A 60% reduction in pallet use, then, would result in a current rule-of-thumb estimate of 10 pallets used per manufactured car. A 60% reduction is clearly a more feasible reduction than a 96% reduction which would be necessary to achieve the use of one pallet per manufactured car suggested by GM staff.

It might also be useful to compare automobile production and pallet production. We can compare Michigan pallet production based on NWPCA estimates and auto industry pallet use, based on this study's estimates. The low estimate of pallets produced in Michigan, 30 million, matches surprisingly well the 29.8 million estimate of pallet use based on auto production figures and 10 pallets per car. Using the larger estimate of state pallet production, 47.9 million, would provide an accurate estimate of pallet use by all industrial users, automotive and others.

Used Pallet Reconditioning Markets. The used wood pallet market is evolving rapidly, and business competition in this market is intense. Pallet reconditioning and recycling competes for used pallets with the industrial wood fuel market, as do landscaping, mulch, composting,

[7]Personal Communication with Sam Baker, Technical Director, National Wooden Pallet and Container Association, June 15 and 20, 1994.

home wood fuel, and recreational surfaces. The continuing high prices of virgin lumber, decreasing supply of public forestlands timber, and perhaps offshore export pressures combine to make the reconditioned pallet market economically attractive to customers and reconditioners. Of 44 respondents interviewed, 29.5% were involved in the pallet reconditioning market. At least one major wood waste processor considers pallet reconditioning more economically appealing than the wood waste fuel market. Reconditioned used pallets are sold for as much as $6 per pallet, and used pallets may command up to $2 for those in very good condition.

Pallet recycling is currently the major market alternative to the wood fuel market. As a higher value-added activity, the pallet recycling market will continue to grow as long as virgin lumber prices remain high. It should also be noted that, while pallet recycling and wood fuel markets compete for used pallets, they also complement each other. We found that 32% of pallet processors recondition pallets *and* use unsalvageable pallets for wood fuel.

Steel nails and bands, dirt, plastic shrink wrap, and corrugated cardboard are the major contaminants in used pallets. Steel is easily removed with magnetic separators. Keeping pallets free of dirt is important and can be a problem if UWW is not handled by adequately trained personnel. Pallets stored in open, unprotected areas for extended periods of time accumulate higher levels of dirt and can make UWW unmarketable. Shrink wrap and old corrugated cardboard (OCC) must be found through visual inspection and manually removed when observed. Moisture content is typically below 15 to 20%. Used pallets represent a reliable source of UWW supply 260 days per year.

The future of the used pallet market is filled with contradictions. With the ever increasing globalization of the economy on one hand and newly developing corporate environmentalism on the other, the pallet industry continues to evolve rapidly. The increasing dispersion of automotive and other manufacturing throughout North America and offshore makes a closed-loop pallet re-use system unfeasible. Further, the increasing pressure to reduce waste and achieve zero waste generation drives the automotive industry to find alternatives to wood pallets or alternative uses for their used wood pallets. The elimination of the use of wood pallets was a concern to 12% of the respondents who process pallets.

Wood pallet alternatives include plastic pallets or corrugated cardboard pallets. Plastic pallets are durable but their strength is suspect, especially in colder climates where low temperatures can cause inflexible plastic to fracture. Loads may also shift on plastic surfaces. Corrugated cardboard is a convenient pallet material since the used pallet generator can bale the old corrugated cardboard (OCC) for recycling. Secondary OCC markets are currently fetching $160 per ton and a ton of baled OCC is far more compact than a ton of used pallets. However, as with most secondary markets, prices are volatile and fluctuate rapidly. Thus, while corrugated cardboard pallets are currently an economically attractive option, no one predicts high OCC prices to continue indefinitely.

Wood pallet rentals may also pose a threat to used pallet generation, according to 15% of the pallet reconditioners. CHEP USA offers a closed-loop pallet recycling system that may reduce used pallet generation in Michigan. Used pallets may be shipped to Chicago, Indianapolis, or its Lansing facility for reconditioning or reuse. Deteriorated pallet wood parts are reused for animal bedding. The CHEP system offers service and durability in the 48"x40" grocery pallet market, but customers may find the system expensive. The company has been operating in the U.S. for about four years.[8] According to CHEP USA staff, Meijers and Spartan Stores are major customers in Michigan.

In spite of processors' concerns about these trends, they are optimistic about the future of their own businesses in the UWW market. Just over 70% predicted increased volumes in the next three to five years, 18.2% predicted decreased future volumes, and 6.8% predicted no change in volumes.

**Used Pallet Generation by Market Area**

As shown in Table 5, current estimated used pallet generation by the 41 processors and haulers was reported to be 510 TPD (tons per day) and 5,177 CYD (cubic yards per day), for a total of 1,157 TPD.[9] Estimated annual used pallet generation, then, equals 300,820

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[8]Personal Communication with Maggie O'Brien, CHEP USA, September 16, 1994.

[9]This estimate must be regarded as very conservative since we elected to use 50 lbs. as the average pallet weight. We use a formula of five pallets per cubic yard; avg. pallet weight=50 lb., thus, 1 cubic yard=250 lb. and 8 cubic yards=1 ton. Pallets weigh from 30 lbs. for a one-way, expendable pallet to 300 lbs. for a pallet designed

tons. The total capacity for hauling and processing used pallets is an additional 1,600 TPD; thus, capacity is currently being utilized at a rate of 72.3%.

Table 5. Used Pallet Generation and Processing Capacity (in tons)

| Location | Daily Generation (TPD) | Capacity (TPD) | Utilization (TPD) | Annual Generation (TPY) |
|---|---|---|---|---|
| Detroit | 708 | 1,013 | 69.8% | 184,080 |
| Lansing | 20 | 35 | 57.1% | 5,200 |
| Grand Rapids | 148 | 235 | 62.9% | 38,480 |
| Other Area | 281 | 317 | 88.6% | 72,800 |
| Total | 1,157 | 1,600 | 72.3% | 300,560 |

Nearly 48% of the respondents indicated that pallet volumes had increased in the past three to five years. Almost 7% indicated that volumes decreased, and 45.5% did not answer or did not know.

Approximately 63% of the respondents indicated that the amounts or types of wood waste had changed in the last five years. Twenty-five percent indicated there had been no changes, and 11.4% did not know or did not respond.

Data from 19 UWW processors and haulers in the Detroit area indicate that 708 TPD of used pallets are generated per day. Based on a 260-day year, then, the total annual quantity of used pallets generated is 184,080 tons.

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to support 46 engine blocks. Well-made pallets can perform 5-10 years before joining the UWW stream. Another common pallet is the CPC (Canadian Pallet Council) pallet, a multi-use and reusablee pallet that weighs 88 lb. National Wooden Pallet and Container Association (NWPCA) staff estimated that an average pallet weighs 60-70 lbs. If average pallet weight is increased to 70 lbs., then 1 cubic yard=350 lbs. and 5.7 cubic yards=1 Ton. Thus, the total estimate of pallet generation would be 1,418 TPD.

Detroit area based processors and haulers report that their pallet capacity is 1,013 TPD. Total annual capacity for processing and hauling used pallets is 263,380 tons. Thus, they currently utilize 69.8% of capacity.

Data from four processors in the Lansing area indicate that 20 TPD of used pallets are generated by wood waste generators. The total annual quantity of used pallets is 5,200 tons. Lansing area processors' pallet processing capacity is 35 TPD, or 9,100 TPY. The Lansing market for pallets is currently utilizing 57.1% of capacity.

Eleven Grand Rapids area processors and haulers report that 148 TPD, or 38,480 TPY, of pallets are processed and hauled and a processing capacity of 235 TPD, or 61,100 TPY, with a utilization rate of 62.9%.

Ten processors and haulers in other market areas reported 281 TPD of pallets are processed and hauled, and a capacity of 317 TPD, to produce a utilization rate of 88.6%.

Two respondents with two facility locations aggregated their estimates, and we disaggregated them. This disaggregation was not accomplished perfectly. Thus, we present these market area estimates of used pallet generation as preliminary. However, the total estimate of 1,157 TPD, or 300,820 TPY, based on a response rate of 78.6%, stands as a reasonably accurate estimate of used pallet generation in southern Michigan.

**Wood Scrap Generation by Market Area**

Wood scraps are the second most predominant UWW material in terms of the number of haulers and processors handling this UWW stream — 43% of the respondents haul or process wood scraps. Our survey findings indicated that 224 TPD of wood scraps are hauled and processed by 19 firms in the Detroit, Lansing, Grand Rapids, and other markets of this study. Annual generation, based on 260 days per year, would be 58,240 tons. Eight respondents indicated that 86 TPD and 10 respondents indicated that 276 CYD of wood

scraps were hauled and processed.[10] One respondent did not report information about quantities hauled or processed.

Table 6. Wood Scraps Generation and Processing Capacity (in tons)

| Location | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
|---|---|---|---|---|
| Detroit | 41.5 | 80.0 | 51.9% | 10,790 |
| Lansing | 25.0 | 69.0 | 36.2% | 6,500 |
| Grand Rapids | 117.0 | 149.5 | 78.3% | 30,420 |
| Other | 40.5 | 60.0 | 67.5% | 10,530 |
| Total | 224.0 | 358.5 | 62.5% | 58,240 |

Over 63% (n=12) of the 19 respondents indicated that wood scraps volume had increased over the past five years. A decrease in wood scraps volume was indicated by 26.3%, and 10.5% either did not know or did not answer the question.

Eight respondents indicated that their capacity for hauling and processing wood scraps is 158 TPD. Ten respondents indicated that their capacity is 401 CYD, or 200.5 TPD. Total capacity, then, was 358.5 TPD. The capacity utilization rate was 62.5%.

Six Detroit area respondents reported wood scrap hauling and processing. Three reported hauling and processing a combined total of 35 TPD. Two respondents reported a combined total of 13 CYD, or approximately 6.5 TPD. One respondent did not report any quantity or capacity information. Their combined hauling/processing capacity was 80 TPD. Thus, capacity utilization was 51.9% in the Detroit area market. Estimated annual generation of wood scraps based on our hauling and processing data was 10,790 tons in the Detroit area market.

[10]For wood scraps, we use a conversion rate of 2 CY=1 Ton, or 1 CY=1,000 lb. Thus, we converted 276 CYD to 138 TPD. We note that the Wisconsin DNR calculated dunnage (wooden packing material) to weigh 35 pounds per cubic foot (pg. 35), or 945 pounds per cubic yard, in its 1993 wood residue survey.

Three Lansing area respondents reported wood scrap hauling and processing. Two reported hauling and processing a combined total of 16 TPD, and one reported 18 CYD, or 9 TPD, for a total of 25 TPD. The capacity for hauling and processing wood scraps was estimated to be 69 TPD. The capacity utilization rate, then, was 36.2%. Annual generation of wood scraps based on our processing and hauling data was 6,500 tons.

Six Grand Rapids area respondents reported wood scrap hauling and processing. Two reported their combined hauling and processing of 32 TPD. Four reported 170 CYD, or 85 TPD, totaling 117 TPD of wood scraps hauled and processed in the Grand Rapids area. Annual generation of wood scraps based on our processing and hauling data was 30,420 tons. The combined capacity for respondents reporting both weights and volumes was 149.5 TPD. Thus, the capacity utilization rate for Grand Rapids area respondents in hauling and processing wood scrap was 78.3%.

Four respondents in other southern Michigan market areas reported hauling and processing a combined total of 3 TPD and 75 CYD, or 40.5 TPD of wood scrap. The total reported capacity of the four respondents was 60 TPD for a utilization rate of 67.5%. Annual generation of wood scraps based on our processing and hauling data was 10,530 tons.

**Construction Debris Generation by Market Area**

The literature generally treats construction debris and demolition debris as one common stream, known as C/D in the literature. However, we designed our survey instrument to elicit responses specific to either construction or demolition debris. We find the physical characteristics of these two streams to be quite different. Since demolition debris wood waste is often contaminated with lead-based paints, this material can pose a significant threat to human health and the environment.

Construction debris, as Donovan points out, contains "wood scraps from laminates used for sheathing and flooring, laminated beams, moldings and casings, dimensional lumber, painted or stained, trim, and siding." Demolition debris wood, in addition to lead-based paints,

contains painted sheathing, plaster, preservatives, asphalt shingles, tar paper, or insulation.[11] Therefore, demolition debris requires greater handling to separate materials than does construction debris.

Estimates of C/D debris generation are deeply problematic. Donovan asserts in the NYSERDA report that wood content of C/D debris varies from 15 to 85% (emphasis added). A study by the Greater Toronto Homebuilders indicated that 40% of residential construction waste is wood and wood products.[12] Thus, our self-reported estimates of C/D generation may be preliminary, but they represent a starting point for assessing a very difficult component of the UWW stream.

As no standardized methodology for collecting data on the generation of MSW, including UWW, currently exists,[13] it is our intent that this study will contribute to the formation and practice of sound protocols for gathering and analyzing waste generation data. By taking one component of the solid waste stream and subdividing it into its constituent parts, we can better understand the sources and parameters of its generation and associated characteristics, particularly in terms of disposal practices and potential for secondary market use.

More than 22.7% (n=20) respondents indicated that they hauled or processed 348.5 TPD of construction debris.[14] The total annual quantity of construction debris processed and hauled was 90,610 tons. The estimated capacity for hauling and processing construction debris was 1,004.5 TPD, or 261,170 TPY. Thus, the capacity utilization rate was 34%.

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[11]Donovan, C.T. and Environmental Risk, Ltd., Wood Waste in the Waste Stream: Characterization and Combustion Emissions, 1992, p.3-6.

[12]ibid., p. 3-6.

[13]Office of Technology Assessment, Facing America's Trash: What Next for Municipal Solid Waste, OTA-024, U.S. Government Printing Office, 1989, p.76. This report emphasized this methodological gap, and interviews with MDNR, local, and private sector waste management staff uniformly corroborated that this gap remains a serious problem for solid waste planning.

[14]Volumes reported in cubic yards were converted to weight measures by calculating 2 cubic yards per ton. We note the wide variance of wood composition discussed in the NYSERDA report as well as noting that the 1994 Oakland County solid waste update revised its C/D conversion from 1:1 to 2 gateyards to 1 ton. A gateyard is a compacted cubic yard of wastes "coming through the gate."

| Table 7. Construction Debris Generation (in tons) | | | | |
|---|---|---|---|---|
| | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
| Detroit | 180.5 | 969.5 | 18.6% | 46,930.0 |
| Lansing | 3.0 | 5.0 | 60.0% | 780.0 |
| Grand Rapids | 12.0 | 20.0 | 60.0% | 3,120.0 |
| Other* | 153.0 | 10.0 | --- | 39,780.0 |
| Total | 195.5 | 994.5 | 19.7% | 90,610.0 |

*Daily generation includes two firms, but daily capacity for only one firm. Therefore, the utilization rate cannot be calculated. The data for this group is excluded from the calculation of total utilization rate.

Six Detroit area respondents indicated that they hauled or processed a combined total of 180.5 TPD of construction debris. They reported a combined capacity of 969.5 TPD for a utilization rate of 18.6%. This rate reflects one processor indicating that he is operating at 10% capacity. This processor is able to handle a diverse range of materials, and it is not unlikely that his capacity may be more modest than what was reported. In any event, this capacity rate skews the overall average capacity utilization rate.

Four Detroit respondents reported hauling and processing a combined total of 53 TPD (ranging from 7 to 32 TPD). Two respondents reported 255 CYD, which we converted to 127.5 TPD. The combined total of construction debris hauled or processed in the Detroit area, was 180.5 TPD or 46,930 TPY. These respondents indicated their combined capacity for hauling and processing construction debris was 77 TPD, ranging from 7 to 48 TPD. Two respondents indicated their combined capacity was 1,785 CYD, converted to 892.5 TPD. The total capacity for hauling or processing construction debris in Detroit was determined to be 969.5 TPD.

One Lansing area respondent indicated that he hauled or processed 3 TPD of construction debris. That respondent reported a capacity of 5 TPD, for a utilization rate of 60%. Estimated annual generation of construction debris was 780 tons.

One Grand Rapids area respondent indicated hauling or processing 12 TPD of construction debris and a capacity of 20 TPD for a utilization rate of 60%. Estimated annual generation of construction debris was 3,120 tons.

Two respondents in other southern Michigan market areas hauled or processed 153 TPD of construction debris. One respondent reported 3 TPD. The other reported 300 CYD, converted to 150 TPD. Estimated annual generation of construction debris was 39,780 tons.

The combined capacity for hauling or processing construction debris of these two respondents was 160 TPD. One reported 10 TPD capacity. The other did not report capacity information, so we cannot calculate a capacity utilization for this group.

**Demolition Debris Generation by Market Area**

Only three respondents reported hauling and processing demolition debris. However, given the regulatory concerns associated with this UWW stream, the small number of firms hauling and processing demolition is not surprising. This may change if regulatory treatment of this UWW stream component is relaxed towards its use as boiler fuel and in other secondary materials.

The EPA Appeal Board's decision and opinion in the Genesee facility air permit appeal (September 1993) suggest that this change in federal regulatory treatment is clearly underway. This decision allows the use of demolition debris as a fuel as long as strict handling standards are established and implemented. The decision specifically allows fuel cleaning, that is, removal of lead-treated wood, as BACT (best available control technology) for lead emissions.

| Table 8. Demolition Debris Generation & Processing Capacity (in tons) | | | | |
|---|---|---|---|---|
| | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
| Detroit firms | 125 | 875 | 14.3% | 32,500 |
| Lansing | -- | -- | -- | -- |
| Grand Rapids | -- | -- | -- | -- |
| Other* | 8 | 10 | -- | 2,080 |
| TOTAL | 125 | 875 | 14.3% | 34,580 |

*Daily generation includes two firms, but daily capacity for only one firm. Therefore, the utilization rate cannot be calculated. The data for this group is excluded from the calculation of total utilization rate.

The total amount of demolition debris hauled and processed in our study area, based on the responses from three respondents, is 133 TPD, or 34,580 TPY[15]. A breakdown is shown in Table 8. This amount undoubtedly underreports the demolition debris stream in our study area, but development of a more precise estimate is beyond the scope of our project. The total capacity was reported to be 875 TPD; the utilization rate, then, was 14.3%.

One Detroit area respondent reported hauling 250 CYD, or 125 TPD, of demolition debris. His capacity was estimated to be 1,750 CYD, or 875 TPD. Thus, his capacity utilization rate was 14.3%. His annual estimated processing was 32,500 tons.

In its *1990 Solid Waste Management Plan Update* published in April, 1994, Oakland County estimated C/D generation of 138,430 TPY, or 379.26 TPD, for 1990. No attempt was made to separate out the construction and demolition streams. This estimate was derived from a 1980 survey by Camp Dresser and McKee, which was conducted to assist the development of

[15]We find the same conversion factor we have used for construction debris and wood scrap to be appropriate for demolition debris as well (2 CY=1 Ton).

Oakland County solid waste planning. This C/D stream is composed of concrete, wood scraps, metals, and plastics.[16]

Wayne County solid waste management data estimates that 13.2 million tons of solid waste were generated in 1989, including 6 million tons generated by the residential sector, 4.9 million tons by the commercial sector, 1.4 million tons by the industrial sector, and 870,000 tons in a "special" category including C/D debris. C/D was estimated to be 516,000 TPY.

There was no reported hauling or processing of demolition debris by Lansing or Grand Rapids area haulers or processors. However, Lansing-based Daggett Sand and Gravel hauled 65,000 cubic yards of demolition material in 1991, according to the most current Ingham County Solid Waste report (1992), and deposited that demolition debris in their Type III landfill. We were unable to obtain any further information from the Daggett operation. However, county solid waste staff indicated that Daggett processes and sells as much of its demolition debris in secondary markets as feasible in order to extend the life of their landfill. It is five or six years from reaching its capacity, according to county staff.

The other two counties in the mid-Michigan area, Clinton and Eaton, take a combined total of 25,000 cubic yards of demolition waste to the Daggett facility, based on 1988 estimates in their 1990 solid waste plans. It should be noted that, while these reports characterizing waste deposited at the Daggett facility use the term demolition waste, the same reports also use the term construction debris interchangeably with demolition debris.

Kent County solid waste management data indicated that wood makes up 6.4% of the waste stream, or 97.1 TPD and 35,441 TPY. No attempt was made to disaggregate the C/D stream. In all likelihood, this estimate is based solely on a waste generation per capita rate, and the percentage of composition assigned to wood waste is arbitrary.

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[16]Wood waste generation was estimated to be 19,897 tons/year. This estimate was derived from employee generation factors of 1.05 tons per employee per year in the commercial sector and 6.01 tons/emp./yr in the industrial sector. The wood waste percentage of the total waste stream was calculated to be 2 to 4%, depending on the sector of generation. These generation factors were derived from the 1980 Camp Dresser and McKee survey.

Two respondents in the other market areas reported hauling and processing 3 TPD and 10 CYD, totaling 8 TPD of demolition debris. One respondent reported a capacity of 10 TPD, but the other respondent did not report capacity. The utilization rate, then, for the respondent reporting was 30%.

**Tree Trimming Residue Generation by Market Area**

The Great Lakes states produced 2.7 million cubic yards of urban tree and landscape residue in 1993, according to a draft report by the International Society of Arboriculture (ISA) Research Trust prepared by the NEOS Corporation. Residue generation was not disaggregated by state.

This report quantified seven categories of urban tree and landscape residue: chips, unchipped logs, tops and brush, mixed wood, fall leaf collection, grass clippings, and whole tree stumps. Commercial tree care firms and electric line maintenance account for 91% of the total national generation of this residue, according to the report.

Our surveys of processors and urban forestry departments provide a strong preliminary assessment of urban tree residue generation. However, a survey of commercial tree care firms was beyond the scope of this project.

Eleven percent of the respondents indicated that they hauled or processed tree trimming residue. Three respondents indicated that they hauled or processed a combined total of 10 TPD, and one respondent indicated 5 CYD, or 1.25 TPD.[17] One did not report any volume or weight. The total reported amount of residue hauled or processed was 11.25 TPD, or 2,925 TPY (based on 260 days/year). The total capacity was estimated to be 13.5 TPD, and the utilization rate was 83%.

[17]As noted in the 1992 Minnesota study on urban tree residue, the variability of bulk residue density is considerable. That report used conversion factors of 6 yds./ton for tops and brush, 5 yds./ton for mixed material, and 3.3 yds./ton for chips. Since we assume that most of the reported quantities of tree trimming residue are chips, we elect to use 4 yds./tons as our conversion factor. That is also the conversion factor used by the McGraw-Hill Recycling Handbook. We also note that the 1993 Wisconsin Wood Residue Study used a conversion factor of 7.4 yds./ton for chips and shavings.

| Table 9. Tree Trimming Residue Generation and Processing Capacity | | | | |
|---|---|---|---|---|
| | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
| Detroit Firms | 9.0 | 9.0 | 100% | 2,340 |
| Lansing | -- | -- | -- | -- |
| Grand Rapids | -- | -- | -- | -- |
| Other | 2.3 | 4.5 | 50% | 585 |
| TOTAL | 11.3 | 13.5 | 83% | 2,925 |

In addition to our survey of processors and haulers, we also conducted a separate telephone survey of 19 city and parks and forestry departments, university grounds departments, and utility tree trimming operations. Responses were received from 16 of the 19 interviews we attempted, giving us a response rate of 84%. Detailed information by area is shown in Table 9.

Four entities responded to our urban forestry residue survey in the Lansing area market: the cities of Lansing and East Lansing, Lansing Board of Water and Light, and Michigan State University. They generated a total of 1,559 tons of urban tree residue from tree trimming and removal operations.

Eleven entities responded to our survey in the Detroit area market, including the cities of Royal Oak, Warren, Farmington Hills, Pontiac, Sterling Heights, Southfield, Waterford, and Detroit, as well as Wayne County and Detroit Edison. Detroit Edison maintains meticulous records of their tree trimming residue. The other respondents relied on estimates, some of which were broad approximations.

For 1993, Detroit Edison generated 132,275 CY of wood chips from their line clearance operations, or 33,068 tons.[18] This level of residue generation will decrease as the company's current line clearance program is completed. Detroit Edison's line clearance program is currently very intensive to combat a problem with downed lines resulting from storm

[18]We used the same conversion factor, 4 yds./ton, for tree residue chips from utility tree trimming operations as we used above for general tree trimming residue.

activity. Thus, the current level of residue generation is expected to decline 25 to 35 percent. However, routine maintenance of lines will continue to generate a substantial level of tree trimming residue.[19]

The city of Detroit is the next biggest generator of urban tree residue with 16,600 tons. Combined with other municipal jurisdictions in the Detroit area, the total residue generated is 17,537 tons.

Results and findings from the Grand Rapids area were incomplete as no estimates were supplied by the city of Grand Rapids or Kent County. Grand Valley State University reported an estimate of four tons per year.

| Table 10. Total Tree Trimming Annual Residue Generation (in tons) | |
|---|---|
| Detroit processors | 2,340 |
| Detroit Edison | 33,078 |
| Detroit area forestry operations | 17,537 |
| Lansing/MSU forestry operations | 1,559 |
| Grand Rapids | 4 |
| Other area processors | 585 |
| TOTAL | 55,093 |

Our total annual urban tree trimming residue generation estimate of 55,093 tons, as shown in Table 10, is very conservative since the response rate from Grand Rapids firms and public forestry agencies was extremely low. In addition, while obtaining data from the commercial tree care industry was well beyond the scope of our study, we attempted to obtain baseline data from tree care/nursery associations in our three market areas. However, we were not able to obtain even preliminary data from these associations. The lack of response from Consumers Power further skews our estimate of the total generation rate.

[19]Personal Communication with Marge Damian, Detroit Edison, July 21, 1994.

Four factors affect the generation of urban tree residue and data reporting:

- budgetary constraints,
- scope of operation,
- jurisdiction, and
- measurability.

Many respondents reported that their departments contracted out their tree trimming and removal operations. Thus, data about these operations were not always complete. Budgetary constraints often restricted operations. For instance, some jurisdictions collected only storm damaged trees. Organizational boundaries also affected amounts reported. Some respondents reported that their county road commissions also trimmed trees and collected residue. Data on these amounts were not obtained nor added to aggregate totals. Finally, residue measurement recordkeeping was a problem for some respondents, who were unable to quantify residue amounts.

Most jurisdictions reported chipping their residue and using the chips in their parks and playgrounds or in compost yards. Many disposal schemes often included free distribution of mulch to the public. However, small amounts were incinerated or landfilled, but these were generally logs that were either too unwieldy for public use as firewood or too large to be chipped with existing equipment.

Future residue production was often viewed as a function of budgetary issues. Some respondents noted that future plans would involve privatization or increased departmental allocations for trimming. Most of the respondents that use chippers for their residue planned to chip more in the future, and one respondent was specifically interested in selling some of his wood residue to a cogeneration facility.

**Wood Waste Generation from Land Clearing**

Eleven percent of the respondents indicated that they haul or process 27 TPD of land clearing wood waste. The total annual quantity of wood waste generated by land development and clearing was 7,020 tons (based on 260 days/yr).

Two Detroit area respondents reported that they haul or process 10 TPD, or 2,600 TPY, of land clearing wood waste. Reported estimated capacity was 10 TPD, for a utilization rate of 100%. No respondents indicated hauling or processing any of this UWW stream in the Lansing or Grand Rapids area markets.

Table 11: Land Clearing Wood Waste Generation
(in tons)

| | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
|---|---|---|---|---|
| Detroit firms | 10 | 10 | 100% | 2,600 |
| Lansing | -- | -- | -- | -- |
| Grand Rapids | -- | -- | -- | -- |
| Other | 17 | 30 | 56% | 4,420 |
| TOTAL | 27 | 40 | 68% | 7,020 |

This component of the UWW stream is relatively more specialized and at the low value end of the market. Since stump removal is frequently required as part of land clearing, heavy-duty removal equipment, in addition to a tub grinder, may be required. Thus, the costs are higher than for other UWW component processing. Finally, dirt and other contaminants make land clearing wood waste a problematic feedstock for most secondary market applications. However, land clearing wood waste is an appropriate feedstock for composting where the dirt contamination is not a problem in terms of end-market use.

**Plywood/Particleboard Waste Generation**

Eighteen percent of the respondents indicated that they haul or process 42.5 TPD (11,050 TPY) of plywood/particleboard, 62.5% reported a combined total of 36 TPD, and 37.5% reported a combined total of 13 YPD, or 6.5 TPD.[20] Their estimated capacity was 67.5 TPD. Thus, the utilization rate was 63%.

Three respondents in the Detroit area market indicated they hauled or processed 6.5 TPD of plywood/particleboard (one respondent reported 2 TPD and two reported 9 CY, or 4.5 TPD)

[20]We use a conversion factor of 2 cubic yards/1 ton.

and estimated capacity of 15.5 TPD (one reported 7 TPD and two reported 17 YPD, or 8.5 TPD). This utilization rate, then, was 42%.

One respondent in the Lansing area market indicated he hauled or processed 1 TPD of plywood/particleboard and estimated capacity of 2 TPD for an utilization rate of 50%.

Three respondents in the Grand Rapids area market indicated they hauled or processed 34 TPD of plywood/particleboard (two respondents reported a combined total of 32 TPD while one reported 4 CYD, or 2 TPD) and estimated capacity of 49 TPD (two respondents reported a combined capacity of 45 TPD and one reported 8 CYD, or 4 TPD) for a utilization rate of 69.4%.

One respondent in an urban market area other than the above indicated that he hauled or processed 1 TPD and estimated capacity of 1 TPD as well for a utilization rate of 100%.

Table 12: Plywood/Particleboard
Waste Generation and Processing Capacity

| | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
|---|---|---|---|---|
| Detroit firms | 6.5 | 15.5 | 41.9% | 1690 |
| Lansing | 1 | 2 | 50.0% | 260 |
| Grand Rapids | 34 | 49 | 69.4% | 8840 |
| Other | 1 | 1 | 100.0% | 260 |
| TOTAL | 42 | 67 | 62.7% | 11,050 |

**Used Railroad Ties**

Nationally, there are 750 million railroad ties in the U.S. and Canada, and approximately 12 million of these ties, or 1.6%, are replaced yearly. For 1991 (the most recent year for which data are available), the Michigan Department of Transportation (MDOT) estimates that there were 3,994 commercial railroad miles of track in Michigan. Calculating 3,088 cross

ties per mile and replacing 64 miles of track per year, over 197,000 ties are replaced annually in Michigan, weighing 14,800 tons.[21]

This estimate seriously underreports the total number of railroad ties requiring disposal since short line private track is not included. The length of short line track owned by large manufacturers is not known. This underreporting is further compounded by not including spent ties generated by the consolidation and removal of existing commercial and private rail lines.

Finally, this estimate is based on annual maintenance. Stockpiled inventories of used ties are not included. At least one rail line in Michigan has a heavy backlog of used ties that must be eliminated. Burlington Northern Railroad staff estimated that 100 million additional ties nationally are "strategically stored" along rights-of-way.[22]

Interviews with railroad staff of the three major Michigan rail lines were conducted to obtain preliminary estimates of used railroad ties annually generated and current disposal methods. Their responses may be compared with national data and information about railroad tie disposal.

Nationally, 62% of used ties are sold to contractors, who then sell them to commercial landscapers or lumberyards. One-fifth of old ties are landfilled, 15% are sold to cogeneration facilities, and 3% are stored.[23] These estimates suggest that approximately 28,000 ties per year are removed in Michigan and not used as fuel or sold commercially. However, none of the staff that we interviewed indicated that any used ties produced by their lines were landfilled.

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[21]Personal communication with Peter Conlon, Association of American Railroads, July 21, 1994. Mr. Conlon provided the formula of 3,088 ties per mile and the weight of a tie, which is 150 lbs.

[22]Glavin, Bill, "AREA President Speaks Out on Tie Disposal," Crossties, January/February 1993.

[23]Conlon, Peter, "The Challenge of Crosstie Disposal," Railway Track and Structures, December 1992.

CSX generates nearly 170,000 used ties annually in Michigan. The entire amount is sold to a contractor. In a 1993 roundtable discussion sponsored by Association of American Railroads Transportation Test Center, the Chief Environmental Officer for CSX, W.J. Turner, indicated that his company was primarily storing ties in their railyards. He indicated that liability concerns prevented them from dealing with contractors. As a result, between six and 10 million ties were being stockpiled.

Grand Trunk has similar problems managing its annual generation of 70,000 used ties. Ties are sorted by quality, and the best are sent to a landscape wholesaler in Canada. Grand Trunk is considering chipping the ties and sending them to a cogeneration facility. The respondent estimated that 200,000 to 300,000 ties are stored in rail yards in Michigan.

ConRail annually disposes of 750,000 ties at the Koppers cogeneration facility in Pennsylvania, which relies exclusively on treated wood waste for fuel.

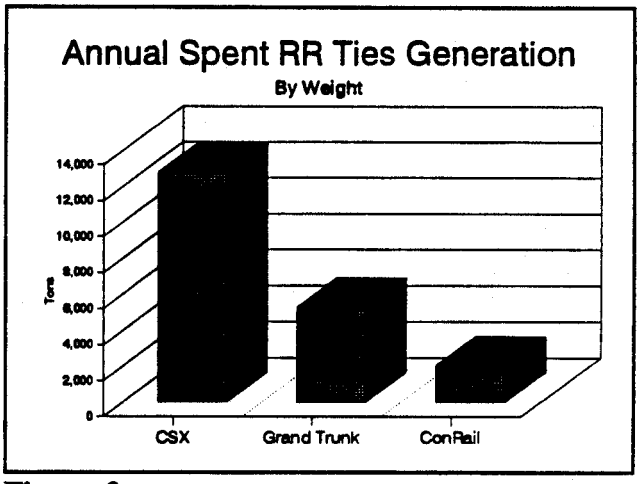

**Figure 3**

We conservatively estimate that Michigan generates 267,000 ties, or 20,025 tons of ties, per year based on our preliminary survey. However, the key question that lies outside the scope of this study is how many ties are stockpiled by commercial and private lines in the state. Based on our preliminary survey, 1,000,000 ties may be a reasonable estimate, which represents 75,000 tons.

Transportation logistics affect the ability of a rail line to find alternate uses for spent railroad ties. One respondent referred to the prohibitive shipping costs associated with transporting used ties to processing facilities. Since many of these facilities are not accessible to rail lines owned by each rail carrier, these carriers do not want to pay another railroad to transport its waste. Similarly, disposal of spent ties can be logistically difficult. Several operators in a the 1993 roundtable spoke of having to use hundreds of cars to haul spent ties to a processor.

Regulatory issues relating to railroad ties as boiler fuel for energy generation are discussed in a later section of this report. If railroad tie combustion can meet strict Michigan air emission and ash disposal standards, it is likely that the quantification of railroad ties will reveal estimates higher than that of this study.

**Other Wood Waste Generation**

Eleven percent of the processors surveyed indicated that they haul or process other wood waste in addition to those categories listed above. Most of these firms indicated that they handled sawdust. Chips and waferboard were the other categories identified.

One respondent in the Detroit market processes 3 YPD, or .5 TPD,[24] for a total annual generation of 130 tons. The utilization rate is 50%. Two respondents in the Lansing market process a combined total of 124 YPD, or 21 TPD, for an annual generation rate of 32,240 tons. Their combined utilization rate was 36.2%. One Grand Rapids and other market respondent indicated that they process 6 TPD, or 1,560 TPY. Overall totals are shown in Table 13.

Table 13: Other Wood Waste Generation and Processing Capacity (in tons)

| | Daily Generation | Daily Capacity | Utilization Rate | Annual Generation |
|---|---|---|---|---|
| Detroit firms | 0.5 | 1 | 50.0% | 130 |
| Lansing | 21.0 | 58 | 36.2% | 5,460 |
| Grand Rapids | 5.0 | 5 | 100.0% | 1,300 |
| Other | 1.0 | 2 | 50.0% | 260 |
| TOTAL | 27.5 | 66 | 41.6% | 7,150 |

[24]Based on the calculations used in both the 1993 Wisconsin survey of secondary wood manufacturing residue generation and the 1994 Michigan survey of the same sector, we use 6 cubic yards per ton. The exact conversion in those surveys is 11.5 pounds per cubic foot.

# Wood Processing and Fuel Prices

More than 45% respondents process their own UWW, 50% do not, and 4.5% did not answer this question. Nearly 39% of respondent firms want to add equipment. In some cases, this addition would upgrade or supplement existing equipment. In other cases, acquisition of processing equipment would represent new processing capacity. In all cases except one, respondents indicated that they want to add tub grinders.

Thirty-four percent of the respondents sell processed UWW to wood-burning facilities, including the Dow Corning Midland facility, the two Viking Energy facilities, and the Cadillac facility.

Table 14. Major Wood Combustion Cogeneration and Electric Generating Facility UWW Fuel Users

| Facility | Location | Year On-Line | Generating Capacity (MW) | Wood Fuel Use (GT) |
|---|---|---|---|---|
| Dow Corning | Midland | 1981 | 22.5 | 290,400 |
| LFC Power | Hillman | 1987 | 18.0 | 250,000 |
| Viking Energy | McBain | 1989 | 16.2 | 190,000 |
| Viking Energy | Lincoln | 1989 | 16.2 | 190,000 |
| AJD Ltd. | Grayling | 1992 | 28.0 | 330,000 |
| Cadillac | Cadillac | 1993 | 34.0 | 450,000 |
| Genesee Ltd. | Flint | Spring 1995 | 35.0 | 452,000* |
| Albion Ltd. | Albion | Planning stages | 40.0 | 440,000* |
| On-Line Capacity | | | 134.9 | 1,700,400 |
| Planned Capacity | | | 75.0 | 892,000 |
| TOTAL | | | 209.9 | 2,592,400 |

All facilities are independent power producers (IPPs) except the Dow Corning facility. SOURCE: Michigan Wood Products Directory and capacity ratings by Public Policy Associates, which reflect information obtained from facility managers.
*(These figures are projected.)

Wood fuel prices currently range from $12 to $35 per ton, according to seven of the 44 respondents who answered the question. Most did not want to divulge pricing information. The mean price among those who did respond was $21.28, and the median was $21, which fits our knowledge of the Michigan UWW fuel market. Price variations depend on supplier relationships, quality of UWW fuel, and transportation distances. Some facilities pay a premium for wood fuel hauled over 100 miles, for example.

There is considerable disagreement about current and future UWW fuel prices. What is known with certainty is that UWW fuel prices have historically been around $15 per ton. In 1993, the 34-megawatt Cadillac facility went on-line and substantially increased demand for UWW in the winter and early spring. This demand surge spiked prices up to over $30 per ton in early 1994. It was reported that, even with these higher prices, the supply of UWW did not adequately meet demand. Severe winter weather caused transportation and UWW processing delays, which exacerbated the market supply shortage. Facilities were adversely affected, and at least one facility was reportedly close to a shut-down because of the supply problem.

Prices have settled back to the low to mid $20s, according to processors and UWW fuel buyers. The over-$30 per ton fuel prices of early 1994 may be regarded as an aberration resulting from the market's attempt to absorb the spike in demand and prices from the Cadillac facility going on-line. However, it is not at all implausible that prices will rise again from the current $20-23 when the Genesee facility goes on-line in the spring of 1995.

Plans by Decker Energy International, Inc. and Wheelabrator, Inc. to develop a wood-fuel power generating facility in Michigan have been detoured but not derailed. Strong opposition from citizens in Charlotte (a small city located 22 miles southwest of Lansing) caused the developers to relocate the site of the proposed facility to Albion (a small city located about 30 miles south of Lansing, between Jackson and Battle Creek). Public opposition was so intense that the entire local Charlotte election in November 1993 turned on the issue of what the opposition called an incinerator. Citizen opposition was particularly inflamed by the proposed use of tire-derived fuel (TDF) and the accusation that waste would be hauled in from Chicago.

The Decker facility will have a 40 MW capacity and require 215,000 BDT/year of fuel. Should the facility be developed in Albion as currently envisioned, it will be the only facility with good access to the Kalamazoo, Battle Creek, Jackson, and Lansing UWW fuel markets. Thus, this facility would significantly add to the fuel demand for UWW in Michigan.

Yet another qualifier must be added to the discussion of future prices. One market anomaly is that a CMS processor established to supply the Genesee facility (CMS is the developer of the Genesee facility) is currently buying UWW and transporting it to the AJD facility (another CMS facility) in Grayling. As a result, processed UWW is being stockpiled there. Some processors have speculated that the current pinch in supply may already reflect the increased demand of the Genesee facility even though it is not yet on-line. A key processor also pointed out that if virgin timber prices decline, UWW prices will decline also. Virgin timber prices are very sensitive to key economic trends, especially housing starts. Thus, a serious downturn in the national economy would cause both virgin and secondary wood prices to decline. Therefore, any predictions about future virgin timber prices and secondary markets are very problematic. The only safe prediction is that the UWW market will continue to fluctuate as demand and supply seek an equilibrium price.

Finally, UWW prices would almost certainly increase dramatically if a proposed Detroit Edison venture to build a medium-density fiberboard (MDF) facility in Detroit is realized. However, the prospects of this plant being built are uncertain. This proposed plant would require over 100,000 tons of UWW per year, or 400 TPD (based on 250 days/year, according to Detroit Edison). The plant would have a distinct advantage over wood combustion cogeneration facilities since it would be located in the "urban wood waste forest." Transportation costs would be low, and the venture would have the potential ability to pay relatively more than IPPs for processed UWW. For example, if the project were to pay $20 per ton, the processor would realize up to $10 to $14 per ton net return as opposed to $3-$5 per ton in net return in shipping UWW to cogeneration facilities 60 to 100 miles from UWW supply markets.

# Competing End Markets

Our survey of processors and haulers elicited data about seven competing end-market uses for UWW (plus an "other" category).

In addition to selling pallet residue for boiler fuel, 30% of respondents indicated that they recondition and recycle used wood pallets. It was emphasized by at least 9% of respondents that pallet reconditioning was a higher value-added use for UWW than boiler fuel. As such, this end-market is relatively more financially attractive. However, in all cases the complementary aspects of pallet reconditioning and using deteriorated pallet residue for boiler fuel was acknowledged. These two end-market options together provide a comprehensive range of use for used pallets that is clearly superior to landfilling or stockpiling.

The second greatest end-market use for UWW was landscaping; 25% of respondents indicated activity in this market. The landscaping market primarily includes using wood for mulch. Mulch use has become increasingly popular with home, commercial, and institutional gardeners and landscapers in recent years. At least one respondent adds different colors to mulch, which some consumers find appealing. This further enhances the value added and increases the market appeal of mulch products. The future of the mulch end-market appears strong with the increasingly greater emphasis on natural and "organic" approaches to gardening and landscaping.

Given the dominance of the boiler fuel market, it is not surprising that firewood was the third most frequently cited competing end-market use; 14% of respondents indicated participation in this market. The level of activity in this market was considerable — from commercial distribution of the product to giving it away on site. The variability may be a function of the volume of UWW processing and hauling and marketing expertise of each firm. The scope of our study precluded a more in-depth understanding of this UWW market.

Few respondents (9%) participated in three other end markets: composting, recreational surfaces, and animal bedding. Composting is frequently included in current municipal recycling programs, and UWW, particularly tree trimming residue and land clearing waste, can be a productive and appropriate feedstock for a good compost mixture.

The variety in the range of the UWW stream precludes simple characterization of the composting end-market for UWW. Since compost operations generally charge tipping fees for UWW, compost operations can become another end-market for UWW processors. Space and technical knowledge requirements for composting are considerable. As discussed in the section on regulatory issues, the future of the legislative yard waste ban is still not resolved, so any predictions about the composting end-market must be very cautious.

The passage of the federal Americans with Disabilities Act (ADA) in 1992 requires the use of handicapper-accessible surfaces for publicly-funded parks and playgrounds. Consequently, a new UWW market in recreational surfaces has developed. As a new and emerging market, this is difficult to analyze in terms of the current and historical data obtained in our survey. Those firms (9%) that indicated activity in this market were optimistic about its growth potential. It is unclear whether UWW processors will enter this end-market as a supplier of both the wood-surfacing product and installation services or exclusively as a product supplier. Our survey elicited information that the labor-intensiveness of installing these surfaces may act as a deterrent to market entry. In addition, technical expertise is essential in installing the surface. A layer of porous material to permit drainage must be installed as a base for the wood chips. Inadequate installation resulting in poorly-drained surfaces will cause rapid deterioration of the wood chip surface.

Animal bedding is a well established alternative end-market use for wood chips and shavings and continues to be an option for 9% of respondents. However, this is not a high-value market activity.

No respondents indicated participation in the composite wood market. However, should the Detroit Edison project to construct a medium-density fiberboard (MDF) facility materialize, the enormous demand for UWW created by this facility would fundamentally alter the

# Issues and Conclusions

Regulatory requirements in Michigan for wood-fired electric generating facilities are very strict. Indeed, these requirements appear to be stricter in Michigan than in states like New York and Minnesota, which are known for strict regulatory controls. Currently, wood "treated" with any chemicals or wood contaminated by non-wood materials (lead-based paint, plastic shrink wrap, or corrugated cardboard) is not permitted for use as fuel because of its anticipated impact on toxic air emissions.

The Michigan Department of Natural Resources Air Quality Division (MDNR-AQD) prohibits the emission of any air contaminant which causes injury to human health or safety, other significant life, or property, or "causes unreasonable interference with the comfortable enjoyment of life and property."[25]

A test burn at the Viking Energy facility in McBain scheduled for September, 1994 will provide data to evaluate the use of six fuel types:

1) creosote-treated wood;
2) PCP-(pentachlorophenol) treated wood;
3) CCA-(chromated copper arsenate) treated wood;
4) particleboard/plywood;
5) construction/demolition (C/D) debris; and
6) tire-derived fuel (TDF).

Regulatory concerns include emissions of particulates (PM 10), hydrogen chloride, heavy metals, polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs), polynuclear aromatic hydrocarbons, formaldehyde, and benzene for all fuel types. For PCP-treated wood, chlorinated phenols are an additional concern.

Primary areas of environmental concern will likely include NOx from binders in particleboard and plywood, chlorinated organics from the PCP and creosote wood

[25]Michigan Department of Natural Resources Air Quality Regulations, Rule 901.

preservatives, carbon monoxide from the TDF, and arsenic and chromium from CCA-treated wood.

The McBain facility's combustion zone is estimated to be about 1800 degrees Fahrenheit and has a system of mechanical cyclones and a series of two ESPs (electrostatic precipitators) to control fly ash emissions. It is expected that the facility's combustion temperatures and pollution control equipment will allow combustion of these materials without toxic emissions exceding regulatory limits. Railroad ties and C/D debris are the most sizeable UWW streams that will be impacted by this test burn.

State regulatory approval of C/D, railroad ties, and other "treated" wood types as fuel for wood combustion facilities would clearly increase the amount of available UWW supply. As things currently stand, these "treated" UWW types must be disposed of in Type II and Type III landfills and are not currently accepted as an available fuel source. Thus, creating a new disposal option for spent railroad ties, C/D, and other "treated" wood types would augment fuel market supply and provide new market supply sources for wood processors.

Our survey of UWW processors and haulers indicated that no processors or haulers handle railroad ties. However, we know that at least one processor is ready to process ties as soon as regulatory approval is granted. As shown above in Figure 3, we estimated conservatively that 20,025 TPY, or 77 TPD, of ties are generated by Michigan rail lines. If ties were allowed to be used as boiler fuel, more ties would make it into the fuel supply stream.

Our hauler/processor survey also underreported the quantity of demolition debris hauled and processed. Again, the quantity of this UWW component would increase (at least in terms of quantity reporting) if processing demolition debris for fuel purposes were within acceptable regulatory limits.

**New Solid Waste Rules**

New rules were promulgated October 7, 1993 for the implementation of Public Act 641. An unresolved issue arising from these new rules regards the regulatory treatment of wood combustion. The issue involves determining whether this combustion is primarily waste

disposal or energy generation. The rules state that "waste that is burned as fuel in a boiler, industrial furnace, or power plant which is permitted...(under) Act 348 (the Air Pollution Act) is exempt from regulation under Act 641, the Solid Waste Management Act." However, the rules do not define boiler, industrial furnace, or power plant, which caused concern to the staff of the Michigan Department of Natural Resources.

As a result, an internal working group was formed by MDNR, and recommendations to clarify the status and regulatory treatment of wood combustion were made to the MDNR executive office but were never acted upon. In brief, it appears that power plants and boilers with a specific power output efficiency would be exempt from regulation under the State Solid Waste Management Act. The intent of MDNR staff in examining this issue was to prevent scenarios where unscrupulous operators would call a facility with minimal energy output efficiency a power plant to avoid regulation under the Solid Waste Management Act.

**Proposed Amendments to the Solid Waste Management Act**

Flow Control. Extensive and very contentious debate has continued for the past several years over solid waste issues, particularly that of flow control. Flow control refers to the intent of jurisdictions to assure compliance with solid waste regulations by controlling volumes of waste and designating the location of their disposal and/or recycling. Under the Michigan Solid Waste Management Act, counties are required to explicitly authorize movement of solid waste between counties. To date, little legislation has been enacted. However, at the behest of Oakland County, legislation was passed in 1994 to reduce the planning interval for county solid waste management plans from 20 to 10 years.

The core of this controversial debate is focused on solid waste flow control. The DNR held a roundtable discussion August 25, 1994 with major stakeholders to garner feedback on three flow control options:

- retain the current system of county-based flow control (no waste export without the authorization of the receiving county),
- establish mandated regional planning where waste can be transported across county lines within each region, and
- abolish all restraints and planning requirements to allow a free market scenario.

County governments and the environmental community were highly critical of any scheme which rejects flow control. Flow control, as argued as the MDNR Roundtable, provides local governments with the ability to evaluate their waste streams and implement integrated solid waste management approaches. A summary of this discussion is included as Appendix E.

In most respects, changes in solid waste flow control will not directly impact the UWW market. However, it is likely that UWW would be impacted at least indirectly. For instance, if a "predatory" landfill market were to operate and tipping fees declined, UWW processors would be forced to cut their tipping fees. That could be very damaging to many processors who operate on thin margins.

Of the limited number of processors who discussed UWW pricing practices, they indicated that their profit margin was derived from tipping fees. Fuel prices essentially covered the cost of processing and transportation. Thus, sharply reduced tip fees would inevitably harm their profitability.

The Carbone Decision. The other major factor affecting local and state regulation of waste management is the U.S. Supreme Court decision in *C & A Carbone, Inc. v. Town of Clarkstown* (New York) on May 16, 1994. In the its opinion, decided by a 6-3 vote, the Court ruled that the Town of Clarkstown's local flow control ordinance was unconstitutional since it violates the Commerce Clause of the U.S. Constitution.

The full impact of the *Carbone* decision cannot yet be determined. However, two suits have been filed in Michigan challenging the State's intrastate flow control provisions. One suit was filed by Waste Management, Inc. in July against Ingham County. The State has filed to intervene in the case. Moreover, Congress is currently considering legislation to permit local flow control of municipal solid waste.

Again, the effects of these developments on UWW may not be direct, and they may be limited. As pointed out above, when wood waste is used as a fuel for boilers, power plants,

or industrial furnaces, it is not covered by the State Solid Waste Management Act. Thus, the direct impact of *Carbone* appears extremely limited on wood waste, particularly as boiler fuel.

Data Requirements and Yard Waste Ban Limitation. More recently, a legislative work group has developed amendments to the State Solid Waste Management Act. Two areas of this group's effort are relevant to this project. First, data reporting requirements for solid waste management plans may be upgraded, although the need for quality data is stymied by the lack of a standardized data collection methodology. Second, a bill (HB 5556) has been introduced in the Michigan legislature to exempt landfill operators from the yard waste disposal ban to go into effect in March, 1995 in cases where the landfill operators manufacture and utilize methane gas.

Stronger data reporting requirements would be helpful to wood waste market development. The absence of reliable waste stream characterization and volume data seriously hinders efforts to encourage greater use of wood waste for fuel and other value-added applications, such as landscape and gardening, recreational surfaces, and composite wood manufacturing.

Difficulties cited by MDNR staff in gathering quality data include issues of proprietary market and processing information, the diverse methods of collection and hauling, and the ever increasing diversity of end points for waste/recycled materials. The level of success achieved by this project to determine the types, quantities, and current disposal methods of wood waste will demonstrate the potential for stricter requirements for quality data reporting of a broader range of specific waste materials.

All interests concerned with waste management in general, and wood waste in particular, agree that accurate and reliable data is necessary to develop the urban wood waste market. Strong support was evident for this project with its goal to successfully execute a sound methodology for gathering accurate and reliable data.

In regard to the bill to exempt certain landfill operators from the implementation of the yard waste ban, it is difficult to assess the impact of such an exemption on the overall status of

current disposal practices of yard waste. However, MDNR staff worry that such legislation would effectively nullify the yard waste ban. If that became the case, demand for other wood waste streams might increase. Currently, compost operators (who have sprung up in significant numbers since the passage of the legislation in 1990 to ban landfilling of yard waste effective in 1995) rely heavily on yard waste, including the brush with its wood constituents, for the appropriate mix of materials for a good compost.

**Conclusions**

Our final survey estimate of 659,328 tons of urban wood waste annual supply in this market study areas compares with estimates of 507,000 tons of C/D waste in the 1991 Illinois study, 2.2 million tons of wood waste and 133,000 tons of pallet residue in the 1993 Wisconsin study, 325,000 tons of urban tree residue in the 1992 Minnesota study, and 868,478 tons of wood waste generated by Michigan's secondary wood manufacturing sector. It is likely that some overlap exists between our study and the secondary manufacturing study.

By disaggregating the urban wood waste stream to nine components — pallets, wood scraps, construction, demolition, tree trimming residue, land clearing residue, plywood/particleboard waste, railroad ties, and other — we have established a level of detail not previously achieved in urban wood waste studies.

Our survey estimate of 300,560 tons of annual used pallet generation, representing 46% of the UWW market, is relatively consistent with annual state pallet production and the use of pallets by the automotive industry. Our conservative assumptions of pallet weight and associated conversions suggest, however, that our estimate of used pallet generation may be low. These results also make it clear that this is a very volatile market, both in terms of the generation of used pallets and end-use market competition for used pallet residue. It requires close monitoring to anticipate market changes in prices and changes in UWW supply from this UWW source. Pallet reconditioning and lanscaping applications represent highly competitive alternative end-use markets.

The construction and demolition component streams are very difficult to quantify and assess. Commingling of C/D with other MSW streams and the regulatory uncertainty about the uses

of demolition debris make this a highly problematic area. The Dow Corning facility, for example, refuses to accept demolition debris for fuel. The CMS Genesee facility, on the other hand, will use demolition debris for fuel when it goes on-line since it sucessfully prevailed in the EPA air permit appeal process.

Tree trimming residue is an area that bears further investigation since our survey estimates were preliminary and not as comprehensive as our survey of other UWW components. Land clearing also represents a small fraction of UWW generation.

Railroad ties represent a challenging area to assess since our research indicated that this stream may represent a significant quantity of UWW. Our survey estimates may underreport current generation rates from annual maintenance as the quantity of currently stockpiled railroad ties is highly uncertain. The results of the Viking test burn will have extensive implicatins for both C/D and railroad tie waste streams.

The constant interplay of regulatory issues, UWW generation, the need for electric generating facility fuel, and other competing end markets creates a rich matrix of interdependent factors affecting the demand for and prices and supply of urban wood waste. As documented in this study, the dynamics are complex and changes can occur rapidly.

The overall UWW capacity utilization rate of 45% is skewed as a result of the very low capacity utilization rate reported in the demolition processing sector. This demolition capacity rate is highly suspect as is the capacity utilization rate for construction debris; further investigation of these market components is warranted before deriving any conclusions based on capacity utilization.

The capacity utilization rates for used pallets, wood scraps, tree trimming residue, land clearing, and plywood/particleboard processing are based on what we consider to be firmer estimates. These rates suggest there is substantial room for growth in the UWW market. The table below summarizes the processing and utilization data presented in this section.

Table 15. Annual Processing and Capacity Utilization Rates for all UWW Components (in tons)

| UWW Type | Capacity | Quantity | Market Share | Utilization Rate | MMBtus(e) |
|---|---|---|---|---|---|
| Pallets | 416,000 | 300,560 | 46.0% | 72.0% | 4,207,840 |
| Wood Scraps | 93,210 | 58,240 | 9.0% | 62.0% | 815,360 |
| Construction | 258,570 | 90,610 | 14.0% | 20% (a) | 1,268,540 |
| Demolition | 230,100 | 34,580 | 5.0% | 15.0% | 484,120 |
| Tree Trim(b) | 3,510<br>--- | 2,925<br>52,168 | 8.0% | 83%<br>-- | 495,837 |
| Land Clearing | 10,400 | 7,020 | 1.0% | 68.0% | 63,180 |
| Plywood/ Particleboard | 17,550 | 11,050 | 2.0% | 63.0% | 154,700 |
| RR Ties(c) | --- | 20,025<br>75,000 | 14.0% | --- | 1,330,350 |
| Other | 17,160 | 7,150 | 1.0% | 42.0% | 28,600 |
| TOTAL(d) | 1,046,500 | 659,328 | 100.0% | 45.0% | 8,848,527 |

(a) Capacity utilization rate is calculated for Detroit, Grand Rapids, and Lansing firms only; other area firms are excluded because capacity was not reported for all firms in other areas.
(b) Survey results of urban forestry and utility line clearance operations did not include capacity data.
(c) Rail line survey did not include capacity data.
(d) This overall capacity utilization rate is based on those firms reporting both capacity and UWW processing. This rate would most likely be greater if all firms reporting quantities of UWW processing included capacity as well.
(e) Conversion factors to convert wood type weight to energy units (MMBtus) were obtained from the *Michigan Wood & Paper Residue Study*: 7,000 Btu/lb for all types except 4500 Btu/lb for tree trimming and land clearing residue.

Moreover, the dominance of smaller, more agile firms (< 15 employees) assures that these firms can quickly adjust and respond to changes in the market. Depending on a firm's financial condition and the capital requirements for making a specific change, timely responses to changes in the market can be anticipated. For example, regulatory approval of railroad ties as boiler fuel could cause tie processing capacity to increase substantially in a short period of time.

While technological and training requirements may be modest in the UWW market, they are by no means absent. It is a market where a modest financial investment and individual initiative can result in a competitive and profitable enterprise. Based on an understanding of this niche market, independent entrepreneurs can become established and thrive in the UWW market. The key elements include:

- knowledge of fuel specifications,
- securing a reliable supply commitment for end-user customers,
- technical capacity to process UWW for fuel, and
- delivering UWW to meet those specifications on time.

It has been estimated that primary forest industry residues could provide the equivalent of about 750 MW of electric power. That is approximately 3.75% of the total electric power capacity of 20,000 MW in the state.[26] Our study estimates that 90 MW of electric generating capacity can be produced from the UWW supply in our study area.[27]

Our study finds that the on-line wood fuel facilities that use urban wood waste for fuel require 1,700,400 TPY and that the total UWW supply is 659,328 TPY, or 39% of the required supply. With the Genesee facility scheduled to go on-line in the near future, the fuel requirements will increase to 2,152,400 TPY.

It is worth noting that the Genesee facility will access the UWW supply stream and rely more heavily than other facilities on urban tree residue and demolition debris, the lower quality components of the UWW supply stream. The implication here is that an effective fuel supply strategy will include a range of supply options that avoid sole reliance on one or another UWW stream.

Wehave noted throughout this report that, while making a substantial contribution to the body of knowledge of urban wood waste, many of the findings and conclusions presented here

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[26]Tom Stanton, *Biomass Energy: It's Not Just for Breakfast Any More,* October, 1993.

[27]Assuming 15,000 Btu/kwl, then 8.8 million Btus is equivalent to 590,000 MWH. Converting to MWH by dividing that figure by 1000, the result is 590 MWH. Finally, assuming a 75% facility availability factor and 8,760 hr/yr, the result is 89.8 MW.

should be considered preliminary. We strongly urge that additional research be conducted to further illuminate the issues we have discussed. This report should serve as an important basis for such work. More broadly, they should inform a variety of parties with important interests in wood waste supply. These parties — generators, processors, haulers, and end users — each have an immediate economic stake in the current status and future direction of this market. Perhaps most important, however, is that policy makers should now have a clearer, more detailed picture of this key component of the solid waste stream. It is the intent and hope of the research team that this will inform the process of devising legislative and regulatory policies that will improve both the economic and environmental landscape of Michigan.

# Urban Wood Waste in Michigan

# Appendices

APPENDIX A

**1994 URBAN WOOD WASTE SURVEY**

**OF BROKERS AND PROCESSORS**

My name is_____. I am calling as part of a seven-state effort funded by the Council of Great Lakes Governors. (*If asked,* this work is being done by Great Lakes Consulting Services). We want to establish some basic information about the generation of urban wood waste in your territory and its current use or disposal. My questions will take about 15 minutes of your time. Is now a good time for you? (*If not, schedule a call back time.*)

RESPONDENT'S
NAME_____TITLE/POSITION_____
COMPANY_____
ADDRESS_____
CITY/STATE/ZIP_____
PHONE(___)_____DATE(s) INTERVIEWED_____

Location of this facility_____
Other facility locations_____

1. What kinds of wood waste do you haul or process?

1___pallets/dunnage
2___wood scraps
3___construction debris
4___demolition waste wood
5___railroad ties
6___tree trimmings (right of way/grounds maintenance)
7___land clearing/conversion
8___plywood/particleboard
9___Other

2. How many wood waste generator customers do you serve?_____

a. Who are your major generators of wood waste?

1._____
2._____
3._____
4._____
5._____
6._____
7._____

b. Are your customers in the___Detroit area?
___Lansing
___Grand Rapids

3. What is the CURRENT WEIGHT and VOLUME of the types of wood waste you haul or process?

| | Avg. Amt./day (*or wk., mo., or yr.*) Weight Tons | Volume Cu.Yd. | # of units |
|---|---|---|---|
| Pallets/dunnage | ___ | ____ | _____ |
| Construction debris | ___ | ____ | _____ |
| Demolition waste wood | ___ | ____ | _____ |
| Railroad ties | ___ | ____ | _____ |
| Tree trimmings | ___ | ____ | _____ |
| Land clearing/conversion | ___ | ____ | _____ |
| Plywood/particleboard | ___ | ____ | _____ |
| Wood scraps | ___ | ____ | _____ |
| Other | ___ | ____ | _____ |

4. Is your company's <u>capacity</u> for hauling and processing wood waste greater than your current hauling and processing?___YES___NO

If YES, what are the amounts of your capacity for the types of wood waste processed by your company?

| | Avg. Amt./day (*or wk., mo., or yr.*) Weight Tons | Volume Cu.Yd. | # of units |
|---|---|---|---|
| Pallets/dunnage | ___ | ____ | _____ |
| Construction debris | ___ | ____ | _____ |
| Demolition waste wood | ___ | ____ | _____ |
| Railroad ties | ___ | ____ | _____ |
| Tree trimmings | ___ | ____ | _____ |
| Land clearing/conversion | ___ | ____ | _____ |
| Plywood/particleboard | ___ | ____ | _____ |
| Wood scraps | ___ | ____ | _____ |
| Other | ___ | ____ | _____ |

5. In your company's business, have the amounts of wood waste or types of wood waste changed in the last five years?___YES___NO___DON'T KNOW

5a. Were the volumes more or less than what they are currently?

| | Past Avg. Amt/day(wk/mo/yr) OR +/- change | | |
|---|---|---|---|
| Pallets/dunnage | ___ | ____ | _____ |
| Construction debris | ___ | ____ | _____ |
| Demolition waste wood | ___ | ____ | _____ |
| Railroad ties | ___ | ____ | _____ |
| Tree trimmings | ___ | ____ | _____ |
| Land clearing/conversion | ___ | ____ | _____ |
| Plywood/particleboard | ___ | ____ | _____ |
| Wood scraps | ___ | ____ | _____ |
| Other | ___ | ____ | _____ |

6. What changes in the volumes of wood waste do you foresee in the next 3-5 years in your business?

____Increased volumes(if so, how much of an increase and why)

_____

_____

_____

_____

____Decreased volumes(if so, how much of a decrease and why)

_____

_____

_____

_____

___Change in wood waste <u>types</u> hauled and processed by your business_____

_____

_____

_____

7. Do you process (hog) your own wood waste?____YES____NO

8. Do you want to add equipment to process wood waste?

___YES___NO

a. If YES, what kind of equipment would you want to obtain?

_____Tub grinder_____Hammermill

_____Other(please identify)

9. Do you sell wood waste for fuel to wood burning facilities?

___YES___NO_____*(please identify)*

10. What are current processed waste wood fuel prices?

_____/ton

10a. What are specification requirements?_____

_____

_____

_____

_____

11. What other end market customers do you sell processed wood waste to?

_____Landscaping

_____Compost material

_____Recreational surface suppliers

_____Composite wood production

_____Other*(please describe)*_____

12. What are prices currently received for these end market sales?

_____Landscaping
_____Compost material
_____Recreational surface suppliers
_____Composite wood production
_____Other

13. What factors currently favor your company's competitive position?_____

_____

_____

_____

_____

14. What barriers does your company currently face or expect to face in the wood waste market?

_____

_____

_____

_____

_____

URBAN WOOD WASTE SURVEY

OF FORESTRY AND LANDSCAPING OPERATORS

My name is_____. I am calling to follow up on our recent letter from Mr. Snyder here at *Public Policy Associates* about our survey to establish some information about the quantities and disposition of wood waste generated in the Detroit, or Lansing, or Grand Rapids area. As you know, disposal practices have changed considerably over the past few years and we want to document these changes and assess future trends. We are conducting this survey for the Great Lakes Biomass Energy Program. My questions will take about 10 minutes of your time. Is now a good time?

RESPONDENT'S
NAME_____TITLE/POSITION_____

COMPANY or GOVERNMENTAL UNIT_____

ADDRESS_____

CITY/STATE/ZIP_____

PHONE_____DATE(s) INTERVIEWED_____

1. Can you state the volume or weight of tree trimming residue generated by your operations?

_____Total Cubic Yards or Tons per week/month/year

(*It is expected that the respondent will report the quantities on a monthly or weekly basis and these quantities will vary depending on the season.*)

Seasonal variation:_____summer(6/15-9/15) _____fall(9/15-12/15)
_____winter(12/15-3/15)_____spring(3/15-6/15)

2. What form is your tree trimming residue in?
(read the following categories and obtain percentages)

_____tops and brush_____chips_____logs_____mixed wood
_____other(please identify)_____

3. How do you currently dispose of your tree trimmings? (*It is possible that there will be more than one disposal option used by the respondent's operation. If so, please obtain percentages of material disposed in each of the following categories.*)

_____Mulching used for own operation
_____Sell for mulch_____price?
_____Give away for mulch
_____Composting used for own operation
_____Take it to composting operation_____fee?
_____Hauled by wood processor/broker for fuel_____fee?

_____Landfill_____fee?
_____Incinerated_____fee?
_____Other(please obtain details)

4. What changes, if any, do you expect in how much tree trimming residue you generate?

5. What changes, if any, do you expect in how you dispose of your tree trimmings?

*That concludes my questions. Thanks for your cooperation and taking the time to talk with me today.*

COORDINATOR SURVEY

URBAN WOOD WASTE PROJECT

We want to establish some basic information about the generation of urban wood waste in your county (or city) and its current disposal. I would like to ask you a few questions that will take about 15 minutes of your time. This survey is a part of a project designed to better understand the current use and potential uses of urban wood waste.

RESPONDENT'S NAME_____POSITION_____

AGENCY_____DATE_____

1. Do you currently compile data on the generation of solid waste in your county (or city)?
___YES___NO

2. Does this data include a separate break out or category for wood waste?___YES___NO

3. What is the estimated quantity of wood waste generated in your county (or city)?

_____lbs._____tons per year/month/week/day(circle one)_____sq. yds.

_____cu. yds._____other

4. Do you consider the estimate of this quantity accurate?___YES___NO
Why or why not

_____

_____

_____

4a. (If the question of methodology has not been addressed above, then ask the following)
What methodology is used to obtain this estimate?

_____

_____

_____

5. Where is wood waste disposed of in your county (or city)?

a) Compost facility_____Name and address

_____Contact name/phone number

b) Wood processors/recyclers_____Name and address

_____Contact name/phone

c) Type III Landfill_____Name and address

d) Type II Landfill_____Name and address

e) Other_____

6. What are the fees for the above?

a)_____b)_____c)_____

d)_____e)_____

7. Can you identify the major generators of wood waste in your county (or city)?

(1)_____(2)_____

(3)_____(4)_____

8. Do you have wood burning facilities in your county (or city)?

____YES____NO_____DON'T KNOW_____NAMES

9. Do you know what this facility (facilities) pays for wood chips?____YES___NO

_____If yes, what are prices paid.

10. Please identify the major waste haulers in your county (or city).

(1)_____(2)_____

(3)_____(4)_____

11. What are major factors affecting wood waste generation and processing in your county (or city)?_____

_____

12. Do you have any reports or other written materials that provide the above information? (Please obtain those reports and written materials)._____YES_____NO

APPENDIX B

## LIST OF INTERVIEWEES

Ray Ayer, Solid Waste Division, City of Ann Arbor

Samuel Baker, Director of Technical Services, National Wooden Pallet and Container Association

Robin Barfoot, Michigan Public Service Commission

Cara Bouche, Forest Management Division, Michigan Department of Natural Resouces

Mike Brinker, Greater Detroit Resource Recovery Authority

Hunter Brooks, Brooks Associates, Ltd.

Marge Damian, Detroit Edison

Terry DeBlaay, Dow Corning Corporation

Mary Felton, Office of Solid Waste, Environmental Protection Agency

Marshall Guerin, Ford Motor Company

Jim Hamilton, Great Lakes Compost Center

Ken Horvath, General Motors Corporation

John Karrakesh, Viking Energy, Inc.

Steve Kelly, Huron Manistee National Forest, U.S. Forest Service

Jim Kilbaso, Department of Forestry, Michigan State University

Ed King, Detroit Edison

Marshall Klaus, former Recycling coordinator of the City of Lansing

George Lipinski, Austin Environmental Consultants

John McCabe, Solid Waste Alternatives Program, Michigan Department of Natural Resources

Bob Moore, Pallox, Inc.

Dan Moran, Wisconsin Department of Natural Resources

Seth Phillips, Chief, Solid Waste Management Unit, Michigan Department of Natural Resources

Mark Polega, Capital Area Landscape Nurserymen Association

Tracy Rayburn, CRSS Capital, Inc.

Elva Revilla, Legislative Staff, Michigan House of Representatives

Karl Roberts, Chrysler Corporation

Ed Stines, Automotive Industry Action Group (AIAG)

Otto Suchsland, Department of Forestry, Michigan State University

Randy Tellez, Air Quality Division, Michigan Department of Natural Resources

Derrick Vannice, International Society of Arboriculture

Phil Vieth, Minnesota Department of Natural Resources

Jack Whittier, NEOS, Inc.

John Youngquist, Forest Products Laboratory, U.S. Forest Service

# MICHIGAN RAILROAD MILEAGE

Independent railroad companies own and operate approximately 4,000 miles of main and branch rail line in Michigan.

| MAIN LINE AND BRANCHES | | | |
|---|---|---|---|
| Operating Railroad * | 1990 | 1991 | Change |
| Adrian & Blissfield Railroad | 0.00 | 19.35 | + 19.35(1) |
| Amtrak | 78.00 | 78.00 | |
| CSX Transportation | 757.00 | 739.00 | - 18.00 (2) |
| Central Michigan Railway | 174.71 | 174.71 | |
| Chicago & North Western Transp. Co. | 165.49 | 165.49 | |
| Coe Rail | 8.10 | 8.10 | |
| Conrail | 451.15 | 450.87 | - 0.28 |
| Delray Connecting Railroad | 3.00 | 3.00 | |
| Detroit River Tunnel | 2.20 | 2.20 | |
| Detroit & Mackinac Railway | 330.58 | 277.25 | - 53.33 (3) |
| Escanaba & Lake Superior Railroad | 204.00 | 204.00 | |
| Grand Trunk Western Railroad | 510.17 | 510.17 | |
| Hillsdale County Railway | 45.60 | 45.60 | |
| Huron & Eastern Railway Co. | 141.10 | 141.10 | |
| Kalamazoo, Lake Shore & Chicago R.R. | 14.63 | 14.63 | |
| Lake Superior & Ishpeming Railroad | 45.66 | 45.66 | |
| Leelanau Transit Co. | 28.00 | 28.00 | |
| Lenawee Countrymark, Inc. | 2.80 | 0.00 | - 2.80 (4) |
| Lenawee County Railroad | 3.80 | 0.00 | - 3.80 (5) |
| Ludington & Northern Railway | 3.00 | 3.00 | |
| Michigan Interstate Railway (Ann Arbor Acquisition Co.) | 46.23 | 46.23 | |
| Michigan Shore Railroad | 9.60 | 9.60 | |
| Michigan Southern Railroad | 22.00 | 22.00 | |
| Mid-Michigan Railroad | 61.73 | 61.73 | |
| Norfolk Southern | 79.09 | 79.09 | |
| Tuscola & Saginaw Bay Railway | 439.53 | 439.53 | |
| Wisconsin Central Ltd. | 437.44 | 425.61 | - 11.83 (6) |
| STATE TOTAL | 4,064.61 | 3,993.92 | - 70.69 |

(1) ASSUMED OPERATIONS ON PORTIONS OF MDOT-OWNED ROW FORMERLY OPERATED BY LENAWEE COUNTY RAILROAD.
(2) TRACKAGE SALE TO DETROIT EDISON AND ABANDONMENTS.
(3) ABANDONMENT BETWEEN GAYLORD - CHEBOYGAN.
(4) TEMPORARY OPERATOR OF PORTION OF FORMER LENAWEE COUNTY RAILROAD. TRACK NOW OPERATED BY ADRIAN & BLISSFIELD RAILROAD.
(5) TERMINATED OPERATIONS.
(6) ABANDONMENT BETWEEN SOO JCT. AND HUMBOLDT JCT.

Source: Michigan Department of Transportation
Prepared by the Statewide Planning Section
with data provided by the Department of Treasury,
1991 State Assessors Reports

APPENDIX D

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APPENDIX E

SUMMARY OF DEPARTMENT OF NATURAL RESOURCES

ROUND TABLE DISCUSSION ON SOLID WASTE MANAGEMENT PLANNING

AUGUST 25, 1994

At the request of the Environmental Policy Committee of the Natural Resources Commission, Department of Natural Resources (DNR) staff arranged a round table discussion with a cross-section of interested parties to discuss three proposals to address regional planning/intercounty waste flow issues in the Solid Waste Management Planning Program. These approaches are: the regional incentive and county plan control approach contained in the draft Solid Waste Management Act, 1978 PA 641, as amended (Act 641) amendments; the mandatory regional planning/free flow approach presented to the Environmental Policy Committee on July 6, 1994; and a free-market approach with no solid waste management plan imposed controls.

The purpose of the meeting was to foster further discussion toward seeking a resolution of regional planning/intercounty waste flow issues. These issues have been the most difficult to reach consensus on during the statewide review of the Solid Waste Management Planning Program portion of Act 641, that the DNR has conducted for the last several years. Following is a brief summary of the discussions from the August 25, 1994 meeting. Also, attached is a list of participants at the August 25, 1994 discussion. In addition to the participants, approximately 80 interested parties observed the discussions.

**Morning Session:**

The morning's discussion was a wide ranging analysis of the proposals and overall views of the various participants.

In general, counties and municipalities strongly favored local control for various reasons including: it provides them the ability to evaluate their wastestream and implement integrated solid waste management systems rather than rely solely on low cost disposal for all solid waste management needs; it is necessary in order for them to be able to effectively negotiate for disposal and other services for their citizens; it allows them to generate predictable data and define disposal needs reliably; it ensures their ability to establish public-private partnerships; and it allows citizens to continue to look to local government for management of solid waste issues.

With some exceptions, the solid waste industry favored less local control for the following reasons: A free-market would produce lower disposal costs; competition should be used as a basis for local decisions; and less local restriction should increase consumer choice. Host negotiations in place of the current siting process was suggested. Some waste industry interests favor continued local control as protective of local choice in solid waste management approaches.

A few members of the round table suggested the Department wait for Federal action by the U.S. Congress on interstate waste control legislation so that Michigan can fit into what they do.

**Afternoon Session:**

During the afternoon, participants were asked to respond to each of the three proposals outlining any necessary adjustments which would make each proposal acceptable. The following summarizes these comments:

PROPOSAL 1 - DNR'S OCTOBER 1993 DRAFT ACT 641 AMENDMENTS BASED ON THE MARCH 1993 WORK GROUP RECOMMENDATIONS.

Regional planning agencies, counties, Michigan Municipal League, Michigan Townships Association, environmental groups, and Ogdon Products Co. were generally supportive of this proposal. Suggested changes included the addition of specific enforcement mechanisms for counties to enforce their plans; use of a direct fund distribution process for county funding instead of a grant program, increased incentives to be provided for waste reduction; and inclusion of industrial waste monofills in planning.

Solid waste industry interests with the exceptions noted in the morning session, industrial monofill interests, and the Michigan Chamber of Commerce felt the proposal was too restrictive on free enterprise. They argued that proposed funding should be used only for planning activities. They suggested the exclusion of certain homogenous industrial waste streams such as coal ash, paper mill sludge, and foundry sands from plan controls and emphasized the potential use for host community negotiations to address local issues.

PROPOSAL 2 - MANDATORY REGION PROPOSAL

Local governmental interests, environmental groups, and Ogdon Products Co. were opposed to mandatory regional planning and preferred the use of incentives to establish regions. They objected to the lack of emphasis on resource recovery. If this proposal were implemented, they felt the size of regions should be established by a committee through a public process.

Most industrial interests were supportive of this proposal and felt region size should be as large as possible.

PROPOSAL 3 - FREE MARKET PROPOSAL

Local governmental interests, environmental groups, and Ogdon Products Co. were opposed to this idea. If this was implemented, it was suggested that State price regulation would be needed and that county and local government would not continue to be involved in the planning process unless a county level veto process for host community siting could be designed.

Industrial interests were generally supportive of this proposal. A few opposed it because it might eliminate smaller operators from the marketplace and therefore eliminate choice and reduce competition. Elimination of export controls and creation of import controls through host community agreements was suggested.

Attachment

PARTICIPANTS IN THE AUGUST 25, 1994 ROUNDTABLE DISCUSSION

Dan Batts - Landfill Management Co.
Rep. Mary Brown - House of Representatives

Steve Chalker - Ingham County Health Department
James Cleary - City Management Corporation
Michael Csapo - Southwestern Oakland County Resource Recovery Authority
Dan Cummins - Georgia Pacific Co.

Carla Davidson - Southeast Michigan Council of Governments
Timothy Dolehanty - Leelanau County

Dawn Furlong - East Michigan Environmental Council

Terry Guerin - Granger Companies

Russell Harding - Deputy Director, DNR
James Hill - Natural Resources Commissioner
Teresa Horsfall-Dietz for Senator Phil Hoffman
Michelle Hurd-Riddick - Saginaw Action Volunteers for the Environment

Curt Kemppainen - Kent County and President of the Solid Waste Association of North America

Dennis Leonard - Detroit Edison Co.
Robert Line - BFI Waste Systems

Warren McArthur - Michigan State Chamber of Commerce
Pat Mc Avoy - Michigan Township Association
Flora McCormack - Wayne County Department of Public Services
Ann Mason - Clinton County
Rep. Susan Munsell - House of Representatives

Greg Nominelli - Michigan Waste Industries Assoc.

Seth Phillips - DNR
Gary Pitsch - Pitsch Wrecking Co.

Carey Rodgers - Michigan United Conservation Club
Gordon Ruttan - St. Clair County

Roger Smith - Oakland County
Genise Smith-Watkins - Michigan Chemical Council
Paula Soos - Ogden Projects Co.
Donald Stypula - Michigan Municipal League
Warren Suchovsky - Menominee County
Larry Sullivan - Charlevoix County
Susan Swindlehurst - Washtenaw County
Jim Sygo - DNR

Kathy Trent - Waste Management, Inc.

Tom Waffen - Southeastern Oakland County Resource Recovery Authority
Bryan Weinart - Michigan Municipal League
Ed Wetherell - City of Riverview